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Draft
Environmental Impact Statement / Environmental Impact Report

FORT CADY MINERALS CORPORATION SOLUTION MINING PROJECT

SCH 91012074

Prepared For

U.S. Department of the Interior
Bureau of Land Management
and
County of San Bernardino

epared By

DAMES & MOORE

JUNE 1993

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DRAFT ENVIRONMENTAL IMPACT STATEMENT/ENVIRONMENTAL IMPACT REPORT
FORT CADY MINERALS CORPORATION
SOLUTION MINING PROJECT
SAN BERNARDINO COUNTY, CALIFORNIA

a. **DESIGNATION:** Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

b. **LEAD AGENCIES:**

U.S. Department of the Interior
Bureau of Land Management
Barstow, California

County of San Bernardino Planning Department
San Bernardino, California

c. **COMMENTS** This Draft EIS/EIR was issued June 4, 1993, and comments on it should be received within 60 days of the issuance date. Comments should be submitted to the Bureau of Land Management (BLM) or the County of San Bernardino at the addresses given below. For further information, contact the BLM or the County at:

Bureau of Land Management
150 Coolwater Lane
Barstow, CA 92311-3221
(619) 256-3591
Attention: Ms. Edy Seehafer

County of San Bernardino, Planning Department
385 N. Arrowhead Ave., 3rd Floor
San Bernardino, CA 92415-0182
(714) 387-4099
Attention: Mr. Randy Scott

d. **PROPOSED ACTION:** Construction and operation of the Fort Cady Minerals Corporation in-situ boric acid production mine and the issuance of associated right-of-way grants and mineral material sales permits.

e. **ABSTRACT:**

In May, 1991, the BLM published its Notice of Intent (NOI) to prepare an EIS and in January, 1991, the County of San Bernardino issued a Notice of Preparation (NOP) of an EIR for the Fort Cady Project. In accordance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), the BLM and County are preparing this joint EIS/EIR. The proposed action consists of the construction and operation of a boric acid production mining and processing facility with the capability of producing approximately 90,000 tons of boric acid per year. The project will include a 273-acre ore body well field, a 10-acre processing facility, a 16-acre gypsum deposition area, and 43.5 acres of ancillary services, including a process water supply well network, a railroad spur, a natural gas pipeline, access roads, and electric lines and facilities. The entire project site will encompass approximately 343 acres. The project will employ in-situ solution mining, a process which involves the injection of a weak acid solution into the ore body to extract the boric acid. Processing of the mineral will take place on-site. The final product and the gypsum, a by-product, will be sold to various markets. Three alternative site locations and a no project alternative were considered. The following issues were identified through the scoping process and are evaluated in this document: geology, hydrology, climate and air quality, noise, biological resources, land use and recreation, visual resources, transportation, cultural resources, paleontological resources, and socioeconomics. If no mitigation measures were implemented, significant adverse impacts would occur to geologic, hydrologic, air quality, biologic, land use, cultural, and paleontologic resources. However, with the implementation of the mitigation measures identified in the document, most impacts would be reduced to a not significant level. Impacts on hydrologic resources (i.e., resulting from the consumptive use of groundwater) and potential land use conflicts with the proposed Area of Critical Environmental Concern may remain significant and unavoidable even with mitigation.

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FORT CADY MINERALS CORPORATION
SOLUTION MINING PROJECT

DRAFT EIS/EIR

This document has been approved for public review.

Henri Bisson

20 MAY 1993

Henri Bisson
District Manager
Bureau of Land Management

Date

Valery Pilmer

5/21/93

Valery Pilmer
Director
Planning Department
County of San Bernardino

Date

Draft
Environmental Impact Statement / Environmental Impact Report

FORT CADY MINERALS CORPORATION SOLUTION MINING PROJECT

Prepared For

U.S. Department of the Interior
Bureau of Land Management

and

County of San Bernardino

Prepared By

DAMES & MOORE

JUNE 1993

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Section ES

Executive Summary

ES.0 EXECUTIVE SUMMARY

This document has been prepared to assess the potential environmental impacts associated with the proposed Fort Cady Minerals Corporation Solution Mining Project. This assessment has been completed in accordance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). It will be used by the U.S. Department of the Interior, Bureau of Land Management (BLM), the County of San Bernardino, other agencies, and the general public to consider the project and its potential impacts prior to the issuance of permits and approvals, which are an important consideration for project approvals.

This executive summary reflects an overview of the entire document, with a special emphasis on the anticipated project impacts and required mitigations. The summary also includes a brief project introduction; alternatives description; and description of other impacts (including cumulative).

ES.1 INTRODUCTION

The purpose of the proposed action is to establish a commercial *"in-situ"* mine to recover boric acid for domestic and foreign use. Boric acid is used in the manufacture of over 150 different industrial products. The production mine and processing facility would have the capability of producing 90,000 tons of boric acid per year.

ES.2 PROPOSED ACTION

The proposed action is on a 343-acre site and would extract boric acid through the injection and extraction of a weak hydrochloric and/or sulfuric acid solution in the alkaline ore body. The extracted solution would be processed to precipitate boric acid crystals, and the crystals would be packaged for shipment or loaded for bulk delivery. The acid would be removed from the ground through an in-situ mining process which, in simplified terms, involves (1) the pumping of a weak acid solution into the ore body 1,400 feet below the surface; (2) a chemical reaction between the acid and the alkaline elements in the ore body which forms boric acid in the solution; and (3) an extraction of the solution by a reverse-pumping process.

The mining operation would produce gypsum as a by-product, which would potentially be sold to the local cement industry or to producers of drywall or soil conditioners.

In addition to the wells and piping located on the ore body, a variety of other facilities would be constructed as part of the project, including:

- a series of water wells and waterlines used to produce and route process water;
- a process plant (approximately 240,000 square feet) consisting of equipment to extract the boric acid from the injected solution, purify and crystallize the boric acid, regenerate the acids used in the injection/extraction process, load and ship the boric acid crystals, generate electricity (natural gas cogeneration unit) and process/store chemicals and products;
- ancillary facilities, including a natural gas pipeline to serve the cogeneration power facility; and an electrical transmission line to link the plant with outside utility systems;
- a deposition pond area to store gypsum;
- a railroad spur to provide bulk shipment capability; and
- a system of access roads to connect site facilities providing access to local road and highway corridors.

The project would employ approximately 80 full-time employees, who would work in alternating shifts 24 hours per day. Based on the size and accessibility of the ore body, the project is expected to be in operation for approximately 130 years.

ES.3 ALTERNATIVES TO THE PROPOSED ACTION

Project alternatives evaluated in this document include:

- *No Action Alternative* — As required by NEPA and CEQA, this alternative reflects the non-use of the site for the project, and provides a basis from which to measure the impacts of the various other alternatives considered.

  Under the No Action Alternative, the adverse impacts identified with the proposed action would not occur. If a right-of-way grant for the project was not issued, claimant rights to pursue a mining operation granted by the General Mining Law of 1872 could continue (as long as it does not cause unnecessary or undue degradation of federal lands) pursuant to §40 CFR 3809.0-6. In addition, the loss of the relatively small beneficial economic and employment impacts associated with the No Action Alternative is not expected to make a substantial difference in the overall regional economy. If the project were not developed, however, the potential for some reduction in the dependence of American manufacturers on foreign imports of boric acid would not change, and the potential to increase foreign export of boric acid would not exist. Other benefits which would not be realized include the potential reduction of consumer costs for certain industrial products and the opportunity to establish a track record of the in-situ mining process for further use of the technique. Based on these considerations, the No Action Alternative would be less economically desirable than the proposed action.

- *Alternative Process Plant Locations* — Numerous site constraints and functional requirements have focused the major alternatives analysis for the project on the location selection for the process plant. Several key elements of the project, including available groundwater, the ore body, and the gypsum deposition area (based on the U.S. Fish and Wildlife Service Biological opinion), cannot be moved. Ancillary facilities and roadway/railway access alternatives to the site are well-defined due to existing infrastructure locations, and the existing high-voltage transmission line which crosses the site also limits the site uses and facility locations. In combination, these key elements and facilities limit adjustments to the location of the process plant due to the interconnected project operating systems. The three evaluated alternative plant sites are located along the proposed access/ancillary facilities corridor between the proposed action site and the main local access road. In general, a decrease in railway/roadway and infrastructure length is matched by a corresponding increase in project waterlines, solution pipelines and access requirements within the site. For all resource areas except visual quality and cultural resources, the three process plant alternative sites were found to cause a negligible difference in impacts when compared to the proposed action. Adverse cultural resources impacts and visual impacts were expected to increase for all of the three alternatives, and hydrology would remain the single significantly-impacted resource area for the three alternatives as it is for the proposed action.

Other alternatives relating to processing changes, different ore body locations, off-site gypsum washing, truck-only transportation, underground or open-pit mining methods, and solar evaporation of extracted well solutions were assessed and not analyzed in detail due to significant environmental sensitivity or feasibility considerations.

Under the National Environmental Policy Act (NEPA), as directed by the Council on Environmental Quality, 40 CFR 1502.14(e), federal agencies are required to identify the agencies' preferred alternative. BLM has evaluated the proposed action taking into account BLM policies, land use plans (particularly the California Desert Conservation Area Plan; CDCA), and the results of the environmental analysis in this EIS/EIR. The proposed action is consistent with BLM policies regarding mining and with the CDCA. The environmental analysis has not identified alternatives with less impacts than the proposed action. Therefore, the proposed action is BLM's preferred alternative.

Section 15126(d)(2) of the California Environmental Quality Act (CEQA) requires that the lead agency (state or local) for preparation of an EIR identify an environmentally superior alternative. If the No Action alternative is the environmentally superior alternative, then the identification is to be made from the other alternatives considered. In the case of the FCMC proposed action, the No Action alternative would be environmentally superior. Based on the results of the analyses for other alternatives summarized above, the proposed action is considered environmentally superior to the other alternatives.

ES.4 MAJOR BLM ISSUES

Major issues addressed in this EIS/EIR included possible threatened and endangered species issues, especially related to the desert tortoise, cultural issues associated with sites in the project area, potential land use conflicts with the proposed Pisgah Crater Area of Critical Environmental Concern and related research activities, groundwater quality and quantity issues, and geologic stability and seismic issues.

ES.5 AGENCY AND PUBLIC SCOPING

The BLM published its Notice of Intent (NOI) to prepare an EIS for the Fort Cady Project in the *Federal Register* on May 10, 1991 (see Appendix A). On January 4, 1991, the County of San Bernardino distributed its Notice of Preparation (NOP) of a Joint EIS/EIR for the Fort Cady Project (see Appendix B). As federal lead agency, the BLM sponsored three public scoping meetings in the Fort Cady project area. Responses to these opportunities for scoping input for the EIS/EIR focused on the following concerns: dates of project operation; amount of land in use; extent of drilling; potential for contamination from the evaporation ponds (which have been eliminated from the revised project); depth the injected acid would penetrate before it is neutralized; effects on desert tortoises; air quality; dust problems; groundwater issues; project financial requirements and economic impacts; and number of jobs created by the project.

ES.6 ENVIRONMENTAL CONSEQUENCES AND MITIGATION

Table ES.6-1 presents the potentially significant impacts resulting from the construction, operation, and closure of the proposed action; mitigation measures proposed to reduce the level of significance of these impacts; and a determination of the significance of impacts after implementation of the proposed mitigation measures. Significant impacts from this project that may not be mitigated to nonsignificance include those associated with an increase in the consumption of groundwater and potential land use conflicts with the proposed ACEC designation for the area. Significant impacts which would be mitigated to nonsignificance are associated with disturbance of desert tortoise habitat.

TABLE ES.6-1

POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

IMPACTS	MITIGATION MEASURES	RESIDUAL IMPACTS
GEOLOGY:		
Construction and closure activities would result in areas with a heightened susceptibility to wind or water erosion.	•Disturbed areas shall be reclaimed.	Not significant.
HYDROLOGY:		
Minor alteration of surface water drainage patterns could result in flooding and erosion during construction and closure.	•Proper engineering design shall be implemented.	Not significant.
Consumptive groundwater use would be approximately 161 acre-feet per year, which would lead to local drawdown of the aquifer and may exceed the estimated safe yield of the aquifer.	•No substantial mitigation is possible. However, the following measures shall be implemented in order to provide additional assurance that adjacent aquifers are not affected by migration of mining process solutions: • Additional monitoring of piezometric levels within the mining area and vicinity shall be carried out and the hydraulic gradient in the ore zone area would be evaluated. • Following completion of mining activities, and as part of closure, extraction wells shall be pumped to remove formation fluids until low-pH fluids have been removed and fluids of normal pH are produced. • Recycled water shall be used to reduce a total water consumption during operational activities.	Significant.

TABLE ES.5-1 (con't.)
POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

IMPACTS	MITIGATION MEASURES	RESIDUAL IMPACTS
CLIMATE AND AIR QUALITY:		
Emissions of SO_2, NO_x, CO, ROG, and PM_{10} from combustion emissions from use of heavy-duty equipment, and fugitive dust emissions from earth-moving activities and vehicular travel over dirt and gravel roads.	•Construction shall be curtailed during high winds (i.e., 10m/sec). •Exposed, disturbed surfaces shall be watered and/or revegetated as soon as practical to prevent wind-blown dust. •Vehicular dust generation on access roads shall be minimized by applying water or approved dust pallatives to all unpaved roads. •A speed limit of 15 mph shall be posted and enforced on all unpaved roads. •The contractor shall establish physical barriers to define the construction site and limit unnecessary disturbance beyond the actual construction zone. •Construction equipment shall be maintained as per manufacturer's specifications.	Not significant.
Emissions of NO_x, ROG, CO, SO_2, and PM_{10} from point and mobile sources would increase during operation.	•The operator shall implement an inspection and maintenance program to reduce fugitive emissions from organic solvent handling equipment (i.e., valves, flanges, and pumps). •The operator shall implement a ridesharing program to reduce commuter vehicle trips. •Optimal combustion conditions shall be maintained on driers and the cogeneration facility in order to reduce emissions of air pollutants. •The baghouse dust collection system, used for PM_{10} removal, shall be inspected, cleaned, and maintained regularly to promote maximum removal efficiency approaching system design levels. •The acid absorption system, shall be inspected, cleaned, and maintained regularly to promote maximum removal efficiency approaching system design levels. •Vehicular dust generation on access roads shall be minimized by applying water or approved dust pallatives on unpaved roads. •After the project is under operation, FCMC shall evaluate the feasibility of paving the main access road.	Not significant.

TABLE ES.5-1 (con't.)
POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

IMPACTS	MITIGATION MEASURES	RESIDUAL IMPACTS
NOISE:		
No significant adverse impacts are expected.	•None required.	Not significant.
BIOLOGICAL RESOURCES:		
PLANTS: Construction and closure impacts on botanical resources would include removal of vegetation at facility sites and access roads; establishment of undesirable weedy vegetation; the compaction of soil which could lead to difficulty in reestablishing native vegetation; and the loss of individuals or small populations of sensitive plant species. Operation impacts would include the potential for further degradation of plant habitat.	•At the end of the project, disturbed areas, including new access reads, shall be recontoured and reseeded with appropriate mixture of native plant species according to BLM specifications.	Not significant.

TABLE ES.5-1 (con't.)
POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

IMPACTS	MITIGATION MEASURES	RESIDUAL IMPACTS
WILDLIFE: Construction and closure impacts on general wildlife and sensitive species would include loss or displacement of individual animals and sensitive desert tortoises; loss or degradation of habitat and habitat features; as well as the fragmentation of desert tortoise habitat. Operation impacts would include the potential for further degradation of wildlife habitat. The beneficial impact of increasing nighttime prey for the California leaf-nosed bat would also result during operation.	•The mine operator shall designate a field contact representative (FCR), with authority to halt all mining activities that are in violation of any stipulations, who shall be responsible for overseeing compliance with protective stipulations for the desert tortoise and coordination of compliance with the BLM and USFWS. •At least 30 days prior to construction activities, a survey shall be conducted by qualified biologists to identify sensitive species and record their location. •When maintenance activities occur outside of areas enclosed by desert tortoise-proof fences, work areas shall be surveyed by the authorized biologist prior to the onset of maintenance to determine whether desert tortoises are present. •A worker education program shall be implemented. •No on-site collection or killing of sensitive plant or wildlife species shall be permitted. •Travel shall be limited to approved roads and off-road use shall be prohibited. If desert tortoise-proof fencing is not constructed along the water pipeline, all project-associated vehicles shall maintain a speed limit of 15 mph on this access road. •When outside of areas enclosed by desert tortoise-proof fences, workers shall inspect underneath any parked vehicles immediately prior to moving the vehicles. •Land disturbance during construction shall be restricted to the smallest area required. •A trash abatement program shall be implemented. •Structures that may function as common raven nesting or perching sites shall not be authorized except as specifically stated by the BLM. •Contractor shall be responsible for post-construction clean-up. Following completion of construction, barriers shall be erected to limit traffic to the main access roads.	Not significant.

TABLE ES.5-1 (con't.)
POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

IMPACTS	MITIGATION MEASURES	RESIDUAL IMPACTS
WILDLIFE (con't.)	•Hazardous material spills, including spills of oils, coolants, grease, diesel fuel, and gasoline shall be cleaned up immediately and the hazardous materials removed. Maintenance yards and containment areas shall be cleaned at the end of the project. •A final inspection shall be conducted to evaluate additional impact to desert tortoise habitat and no later than 90 days after completion of construction activities, the FCR and authorized biologist shall prepare a report for the BLM and CDFG. •Acid solution resulting from spill areas shall be promptly neutralized and cleaned-up to prevent animals and birds from ingesting the solution. •After site rehabilitation, all desert tortoise-proof fence shall be removed. •The sides of the gypsum deposition area shall be gently sloped so as to reduce the possibility of entrapment or drowning. •If feasible, construction shall take place during periods when tortoises are least active. •An authorized biologist shall be required on-site during pre-construction and construction activities which could harm desert tortoises. •An authorized biologist shall maintain a record of all desert tortoises encountered during mining activities. •Construction sites shall be surveyed 30 days, 72 hours, and again immediately prior to the commencement of construction activities. •In general, desert tortoises shall be moved the minimum distance possible to ensure their safety. •Only qualified biologists shall handle tortoises, and accepted protocol for marking and displacement of tortoises shall be followed.	

TABLE ES.5-1 (con't.)
POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

IMPACTS	MITIGATION MEASURES	RESIDUAL IMPACTS
WILDLIFE (con't.)	•An authorized biologist shall instruct appropriate mine employees in the proper method of handling desert tortoises in the event of emergencies involving animals during routine operation of the facility; or FCMC shall retain a local, BLM/USFWS-authorized biologist available on short notice. •All project facilities should be enclosed within desert tortoise-proof fences. •After fence installation, an authorized biologist shall conduct a thorough survey for desert tortoises within all enclosed areas. •Desert tortoises moved from within a fenced site shall be marked for future identification. •A protocol specific to handling of hatchlings shall be developed. •Reduction of habitat fragmentation caused by the above-ground pipeline shall be accomplished by periodic elevation or burial of the pipeline, or construction of ramps over the pipeline. •Reduction of habitat fragmentation shall be reduced through the installation of culverts or underpasses under the access roads and the railroad at all washes and at 0.5 mile intervals. •Pets, especially dogs, shall not be permitted on site. •1,480 acres of off-site desert tortoise habitat lands shall be transferred to the BLM by the proponent to compensate for unmitigated desert tortoise impacts.	

TABLE ES.5-1 (con't.)
POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

IMPACTS	MITIGATION MEASURES	RESIDUAL IMPACTS
LAND USE/RECREATION:		
An inconsistency between the proposed process plant building height and the planning policies of the County Rural Conservation Land Use District and the Airport Hazard Overlay Zone would result during operation. Variances shall be filed and are expected to be approved.	• No mitigation required.	Not significant.
Conflicts between the land use of the proposed action and the research/education purposes of the proposed Pisgah Crater Area of Critical Environmental Concern would result from operation.	•Sensitive areas shall be avoided and above-ground pipelines shall be raised approximately one foot from the ground to reduce impacts to wildlife mobility and habitat fragmentation.	Potentially significant.
VISUAL RESOURCES:		
No significant adverse impacts are expected.	•None required. Although no significant adverse impacts are expected, adverse visual impacts shall be mitigated according to the overall goals of the BLM Visual Resource Management Program. Measures include: ✓ Landform screening shall be incorporated wherever feasible; ✓ Surface disturbances shall be minimized, especially those which highlight lava/soil contrasts; ✓ Structure colors shall blend with predominant background colors; ✓ Night-lighting shall be shielded to minimize off-site glare and visibility; ✓ Implementation of Reclamation Plan measures for vegetation and soil disturbances; and ✓ Graded surfaces shall gradually blend the color, texture, and contour of adjacent sand and lava surfaces.	Not significant.
TRANSPORTATION:		
No significant adverse impacts are expected.	None required.	Not significant.

TABLE ES.5-1 (con't.)
POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

IMPACTS	MITIGATION MEASURES	RESIDUAL IMPACTS
CULTURAL RESOURCES:		
Impacts on cultural resources, including destruction or displacement of cultural deposits and loss of scientific information could occur during construction.	•If feasible, cultural resources shall be avoided. • If previously unidentified cultural resources are encountered, construction activities shall be halted until a qualified archaeologist is consulted regarding the significance of the finds. The BLM shall be notified and concerned Native Americans shall be involved, where appropriate. •Worker and visitor education with respect to not disturbing cultural resources shall be implemented.	Not significant.
PALEONTOLOGICAL RESOURCES:		
Fossils could be subject to destruction and loss during construction.	•A paleontologist shall spot check construction activities in areas where paleontological resources are most likely to be found. •Worker education with respect to the potential for uncovering fossil remains and the legal protection such fossils are afforded shall be implemented.	Not significant.
SOCIOECONOMICS:		
No significant adverse impacts are expected.	•None required.	Not significant.

ES.7 OTHER REQUIRED CONSIDERATIONS

Six other projects have been identified within the vicinity of the Fort Cady project which could cumulatively affect future resources. Projects include an expansion of the existing Hector Mine located adjacent to the project site; the Twin Mountain mine at Pisgah Crater; two hazardous-waste repositories, a Naval Facilities Command Tactical Vehicle Trail, and a waste management facility. Potentially significant adverse cumulative impacts are expected for geology, hydrology, air quality, biology, cultural, and paleontological resources. However, with the implementation of project-specific mitigation measures, all significant adverse impacts are expected to be mitigated to a less-than-significant status with the exception of hydrology and land use. Consumptive use of groundwater would remain an unavoidable significant adverse impact. Potentially significant land use conflicts with the proposed Area of Critical Environmental Concern designation for the area may not be mitigable.

No significant long-term risks to health and safety are expected to result from implementation of the proposed action. In addition, the short-term use of the environment necessary for the proposed action is not expected to result in significant long-term adverse impacts on the productivity of the environment.

Irreversible commitments of natural resources required by this project would include direct consumption of the colemanite ore body; fossil fuels used for transportation and boric acid processing; natural gas used to fire the cogeneration plant; and electrical energy required for the operation of the proposed action. Given the relatively small scale of the project, these impacts would be adverse but not significant. The use of the project site land is also not considered an irreversible impact because the removal of the facilities and the reclamation of the site would ultimately place the site to nearly its original pre-project condition.

Growth-inducing impacts associated with the incremental income and spending associated with the project are not expected to be significant. No major immigration of new households is expected in the Barstow/Newberry Springs area, and the multiplier effect from project-related spending is expected to be small.

Section 1.0

Introduction

1.0 INTRODUCTION

Fort Cady Minerals Corporation (FCMC) is proposing to construct and operate a boric acid production mine and processing facility with the capability of producing 90,000 tons of boric acid per year. The project would include a 273-acre ore body well field, a 10-acre processing facility, a 16-acre gypsum deposition area, 43.5 acres of ancillary services, a process water supply well network, a railroad spur, a natural gas pipeline, access roads, and electric lines and facilities. The entire project site would encompass approximately 343 acres. The project would employ in-situ solution mining, a process which involves the injection of a weak acid solution into the ore body to extract the boric acid. Processing of the mineral would take place on-site. The final product and the gypsum, a by-product, would be sold to various markets (see discussion below in Section 1.2 for a description of these uses).

1.1 PURPOSE OF AND NEED FOR ACTION

The purpose of the proposed action is to establish a commercial "in-situ" mine to recover boric acid for domestic and foreign use. This mine would produce boric acid at a rate of 90,000 tons per year from the extraction of a colemanite ore body located approximately 1,400 feet below the surface.

Boric acid is used in the manufacture of over 150 different industrial products including the following: glass, which is strengthened and able to withstand higher temperatures after the addition of boron; fiberglass, which has been in greater demand in the United States since the energy crisis of the mid-1970's; fire retardants; insecticides; ceramics; detergents (as a replacement for phosphates); and eye wash solutions.

Boric acid is currently produced by three major international companies: U.S. Borax, Inc. and North American Chemical Company, California, and Etibank, Turkey. Fort Cady Minerals Corporation (FCMC), as an additional domestic producer, could potentially lower the dependence of American manufacturers on foreign imports of boric acid (approximately 20 percent of the boron oxide compounds used in the United States are imported). In addition, the additional production from the proposed action could facilitate increased export of boric acid to other countries.

The proposed in-situ mining process could also reduce consumer costs for a variety of industrial products (including those mentioned above). Pilot testing has established that the in-situ mining process is commercially viable.

1.2 LOCATION AND LAND OWNERSHIP

The project would be located near the Pisgah Crater, approximately 17 miles east of Newberry Springs, California, and two and one half miles south of I-40 and the Atchison Topeka and Santa Fe Railway Pisgah siding in the Mojave Desert (see Figure 1.2-1). The project area (see the project area boundary delineated on Figure 1.2-2) consists of approximately 6,500 acres, 343 acres of which would comprise disturbed lands (referred to in this document as "the project site"). Figures 1.2-2a, 2b and 2c reflect the major project components. The Rheox, Inc. (formerly National Lead Chemicals, Inc.) hectorite mine is adjacent to the project site. Land ownership of the site consists of leased lands, fee lands, unpatented lode (leased subsurface mineral rights) mining claims, and millsite claims. Approximately 4,400 acres of the project area are lands administered by the Bureau of Land Management (BLM). FCMC leases mining rights from the following companies:

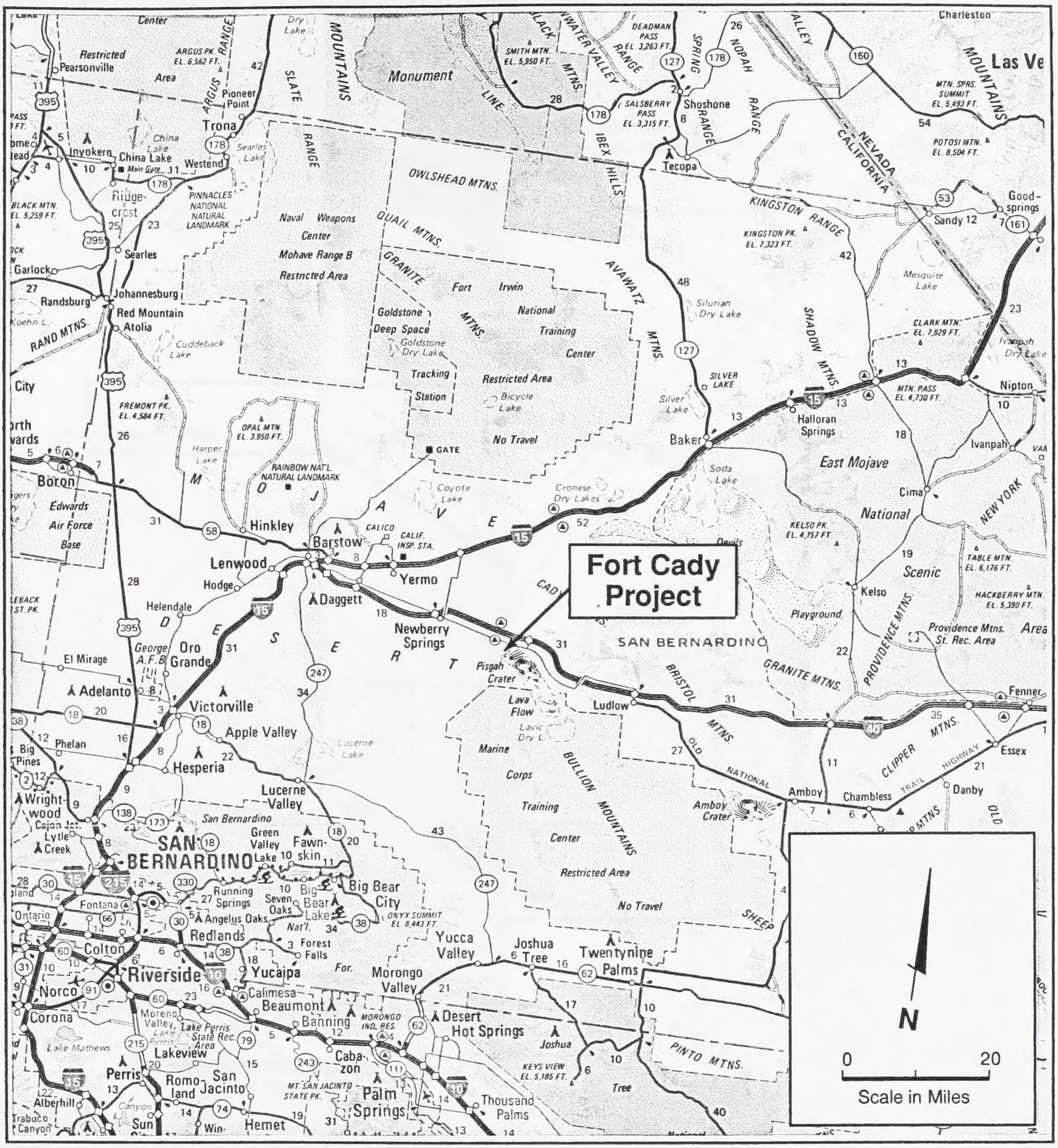
- **Rheox, Inc. (National Lead Chemicals, Inc.)**

  Lode Claims

  Some 240 lode mining claims (totaling approximately 4,967 acres) are held in portions of Sections 26, 27, 35 and 28, T8N R5E, San Bernardino Base and Meridian (SBBM). Both surface and mineral rights are administered by the Bureau of Land Management but have valid claims by Rheox, Inc., through authority of the Mining Law of 1872, as amended. These claims are leased by FCMC.

  Mill Site Claims

  Some 473 mill site claims are held in portions of Sections 19, 20, and 28 T8N R5E, San Bernardino Base and Meridian (SBBM) by Rheox, Inc., and leased to FCMC. Both surface and mineral rights of this property are owned by the Bureau of Land Management.



REFERENCE: AAA California Road Map, 1991

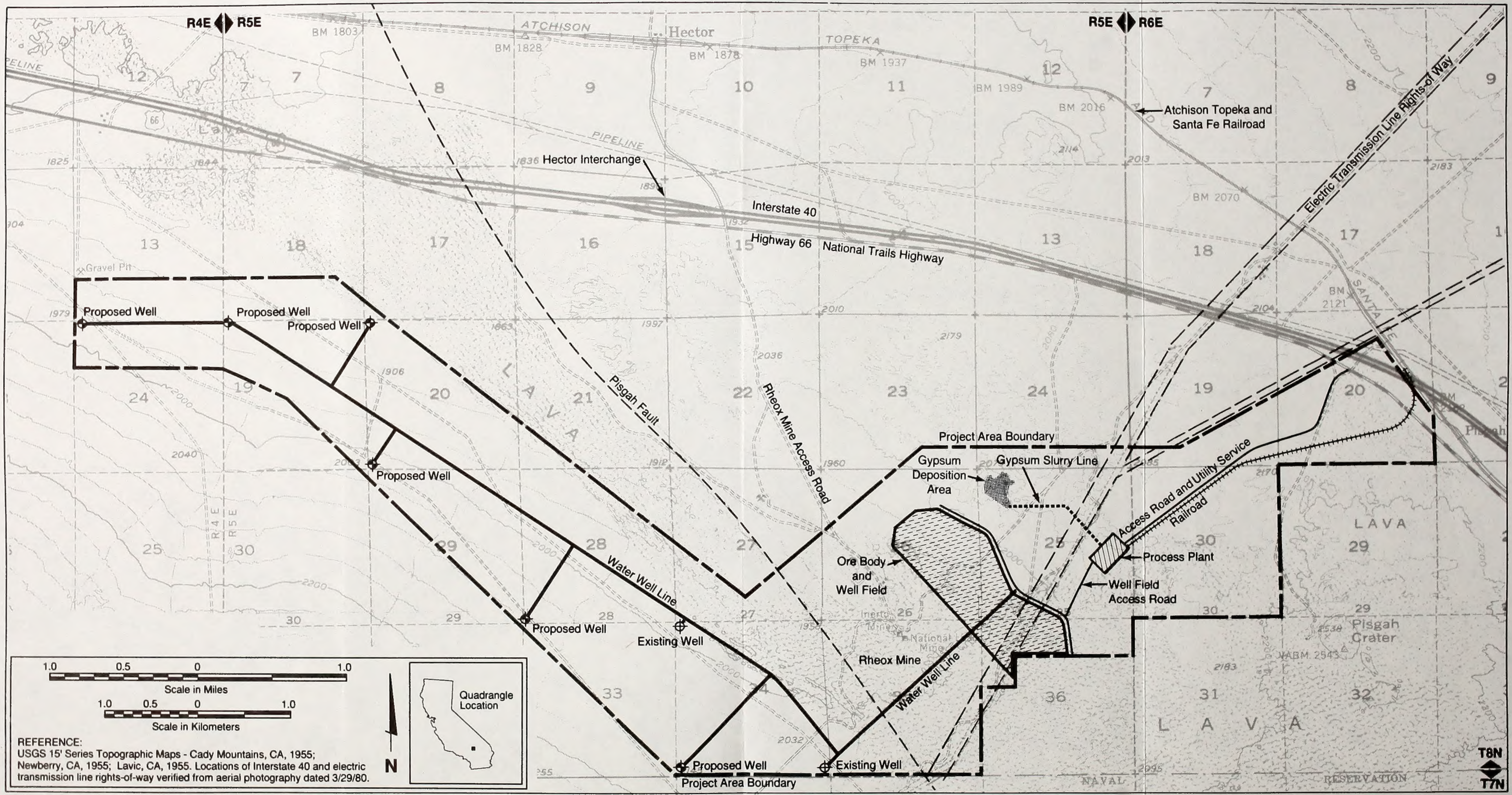
VICINITY OF THE PROPOSED PROJECT

Fort Cady EIS/EIR
Fort Cady Minerals Corporation
Newberry Springs, CA

DAMES & MOORE

21864-001-001.vpp

FIGURE 1.2-1



REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

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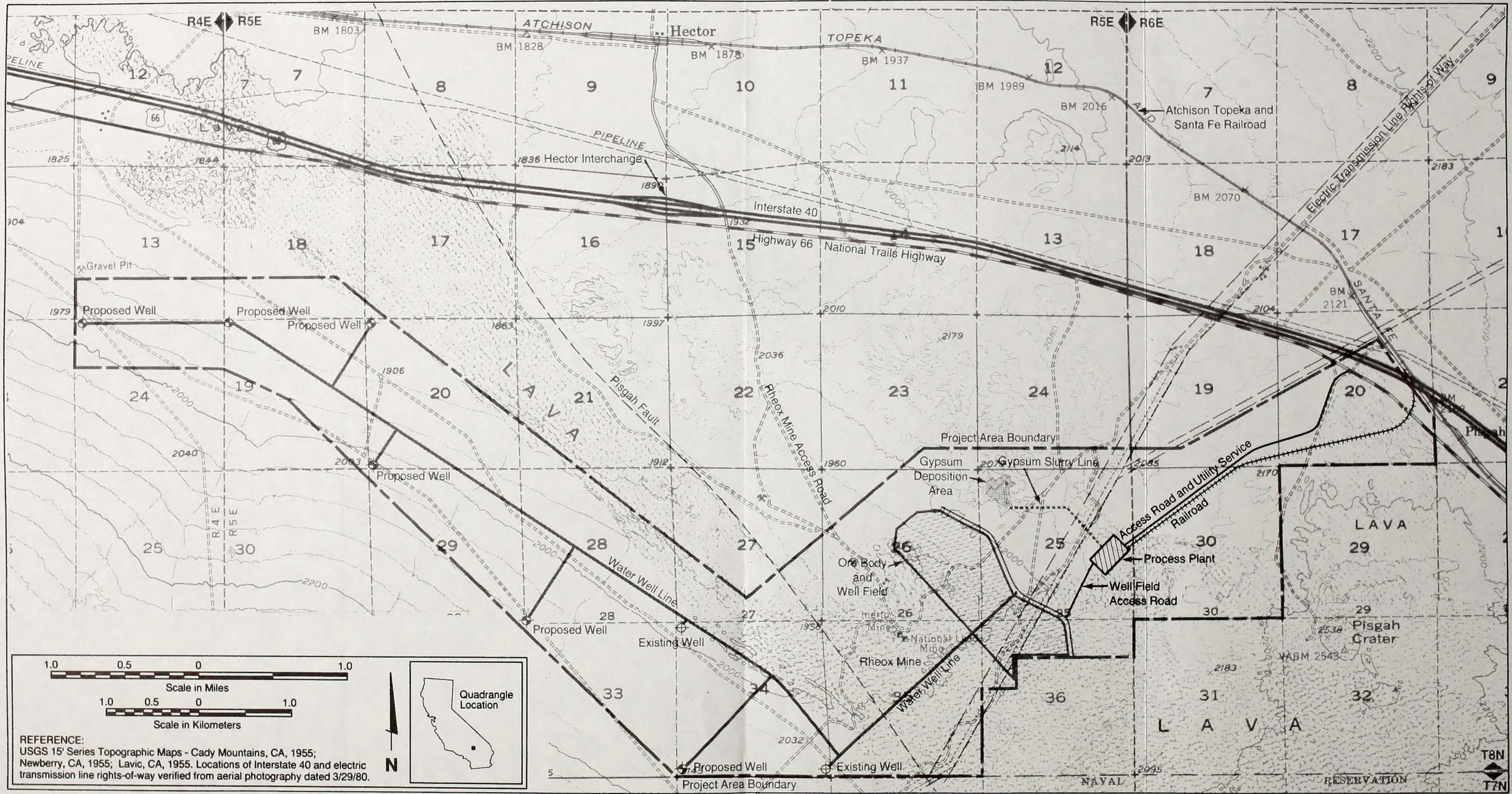
21864-001-001

PROJECT AREA
Fort Cady EIS/EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 1.2-2



REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

PROJECT AREA
PROCESS PLANT, ACCESS ROADS AND UTILITY SERVICE / RAILROAD SPUR

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 1.2-2a

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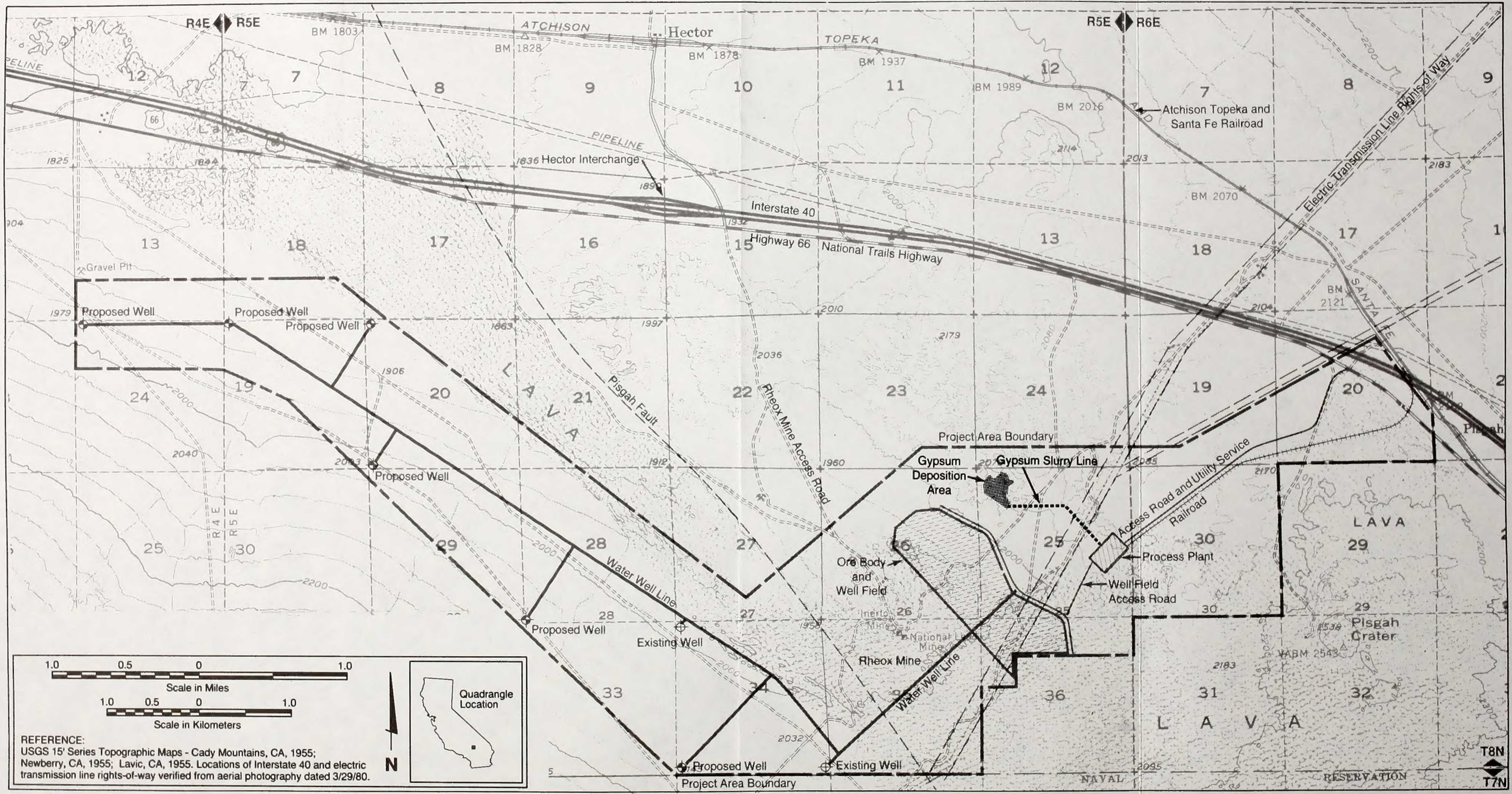

REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

PROJECT AREA
GYPSUM DEPOSITION AREA / SLURRY LINE
Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

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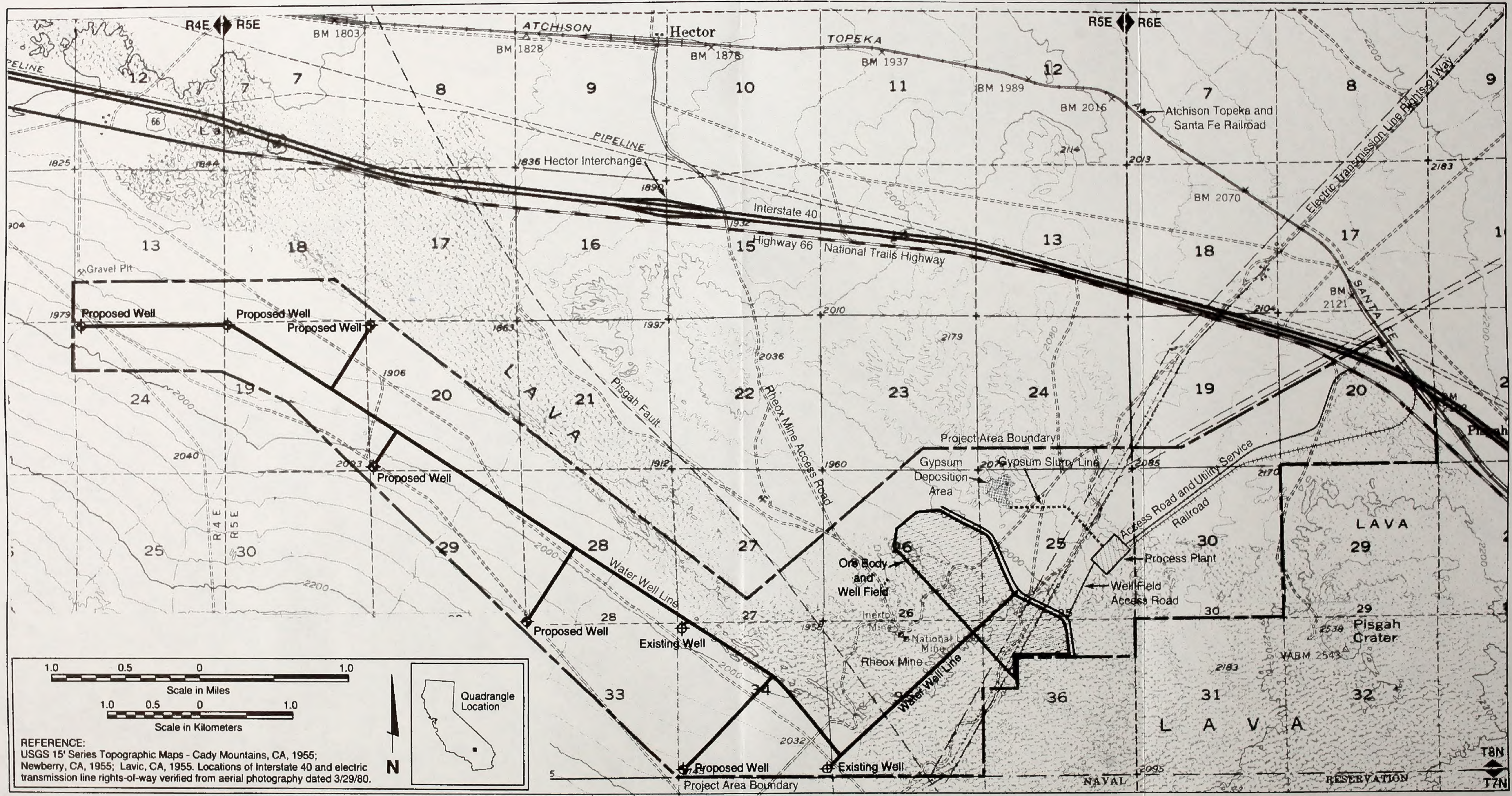
FIGURE 1.2-2b



REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

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21864-001-001

PROJECT AREA
WATER WELLS AND LINES
ORE BODY / WELL FIELD
Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 1.2-2c

Consistent with Section 2 of the Mining and Mineral Policy Act of 1970 and Section 102(a), (8), and (12) of the Federal Land Policy and Management Act, it is the policy of the Department of the Interior to encourage the development of Federal mineral resources and reclamation of disturbed lands. Under the mining laws, a person has a statutory right, consistent with Department regulations, to go upon the open unappropriated and unreserved federal lands for the purpose of mineral prospecting, exploration, development, extraction and other uses reasonably incident thereto.

- **Southern California Edison Company**

The east half and southwest quarter of Section 25 and the north half and northwest quarter and the southwest quarter of the northwest quarter of Section 36, T8N, R5E, SBBM. Both surface and mineral rights of this property are owned by Southern California Edison and leased by FCMC.

- **Southern Pacific Land Company**

The northwest quarter of Section 25, T8N, R5E, SBBM. Both surface and mineral rights are owned by Southern Pacific Land Company and leased to FCMC.

FCMC's fee land holdings include the northern half of the northeast quarter of Section 36, T8N, R5E, SBBM. A total of 247 unpatented lode mining claims are held by FCMC in parts of Sections 26, 27, 28, 33, 34, 35, T8N, R5S; and Section 19 and 30, T8N, R6E; and 473 millsite claims have also been acquired by FCMC. A map of land ownership is presented on Figure 1.2-3.

In addition to the ownership and use of the lands summarized above, FCMC would also be required to obtain access and utility rights-of-way from the BLM for the water line and well sites that occur north and west of the Rheox, Inc. leases, and to ensure that the proper grants for road and rail access and utilities are obtained by the appropriate parties.

1.3 RELATIONSHIP TO POLICIES, PLANS, AND PROGRAMS

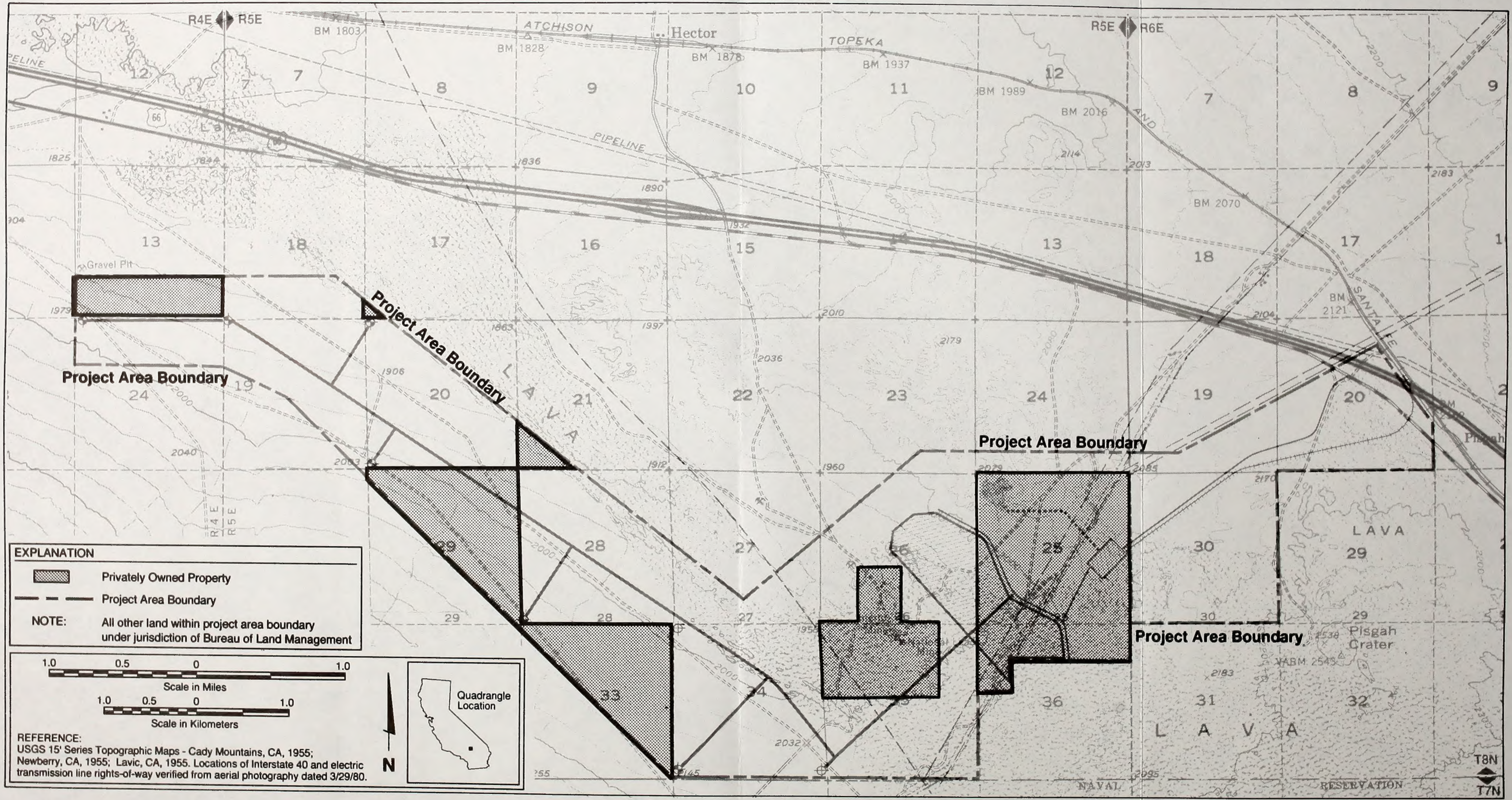
1.3.1 MEMORANDUM OF UNDERSTANDING

Provisions are contained in Federal and California environmental regulations that allow for preparation of joint environmental documents to satisfy both National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) requirements. NEPA Regulations issued by the President's Council on Environmental Quality provide for Federal agencies to prepare joint environmental documents with state and local agencies. CEQA Guidelines contain similar provisions. The BLM and San Bernardino County (along with Fort Cady) executed a Memorandum of Understanding (MOU) on April 15, 1991 to formalize preparation of the joint Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) for the proposed action.

1.3.2 BUREAU OF LAND MANAGEMENT

The proposed Fort Cady project area includes Federal land managed by the BLM and involves unpatented mining claims within the California Desert Conservation Area (CDCA). Under the CDCA Plan (1980), the project area is designated as multiple-use Class M land, which allows for mining operations.

The General Mining Law of 1872 authorizes mining activities on Federal lands. In addition, the Mining and Minerals Policy Act of 1970 and the Federal Land Policy and Management Act of 1976 stipulate that mineral resource development (and the proper reclamation associated with such development) is encouraged by the Department of the Interior. The BLM is required through Federal regulations to review proposed mining projects, including assessment of potential environmental impacts to assure compliance with NEPA. The BLM is also required to assess right-of-way requests for project access and project-related infrastructure improvements (the proposed Fort Cady Project would require a gas pipeline, water pipelines and electric powerlines). The following right-of-way grant applications have been submitted to the BLM: CA-27530, for access roads; CA-27531, for the rail spur; CA-27532, for the water pipeline; CA-28182, for the PG&E gas pipeline; and CA-31199, for the SCE 33-kV electrical transmission line. In general, the BLM must approve operations proposals so long as public lands are not unnecessarily degraded and activities are in the public interest.



REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

LAND OWNERSHIP WITHIN THE PROJECT AREA BOUNDARY

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 1.2-3

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21864-001-001

BLM reclamation policies, as set forth in Bureau Manual Section 3042, would require a review of the proposed project in light of the reclamation aspects and standards discussed in the BLM Solid Minerals Reclamation Handbook H-3042-1.

The BLM serves as the Lead Agency for all compliance associated with NEPA, which focuses on the preparation of a project EIS. The completed EIS, along with other information, would be used to evaluate the proposed action and alternatives, and identify stipulations to be utilized if the project is approved.

1.3.3 COUNTY OF SAN BERNARDINO

The project area includes patented land owned by FCMC. The County is responsible for implementing the California Surface Mining and Reclamation Act (SMARA), which requires that a Mining and Reclamation Plan be adopted and implemented for the proposed action. This plan would describe in detail the mining process and plans for land reclamation at closure of the project. In addition, a County Conditional Use Permit would be required to address specific issues associated with the proposed plan, including required land use variances and conditions of approval.

San Bernardino County represents the project Lead Agency for compliance with all CEQA regulations. Per the MOU, the County would be responsible for the EIR-aspects of the joint document, including a Mitigation Monitoring and Compliance Program. The document would be used by the San Bernardino County Planning Commission, along with other pertinent information, in their review of the proposed action.

1.4 SCOPING AND EIS/EIR PROCESS

Under the requirements of CEQA, the County completed its Initial Study of the proposed action in November 1990 and determined that an Environmental Impact Report (EIR) would be required. The Initial Study identified the following areas of potentially significant impact: (1) geologic hazards; (2) hazardous materials; (3) biological resources; (4) cultural resources; and (5) water supply/water quality.

In June 1990, the Barstow Resource Area of BLM completed an Environmental Assessment (EA) of the proposed action following NEPA requirements and issued a Finding of Significant Impact, requiring the preparation of an EIS on the project. The BLM decision stated that four of the ten criteria defining significance were applicable to this project, including: (1) possible precedent-setting action, since the project is the first of its kind; (2) potential cumulative surface disturbance of approximately 945 acres, well above the recommended threshold for EIS preparation of 640 acres; (3) potential for significant impacts to important cultural resources in the project area of effect; and (4) potential adverse effects on the federally-listed threatened desert tortoise and its habitat. Subsequent to the June 1990 EA, FCMC revised plans for the project and reduced the acreage of surface disturbance from 945 acres to the current 360 acres. Although this is below the BLM's 640-acre threshold for requiring an EIS, other potentially significant effects were still associated with the project, and the BLM and the County felt that preparing an EIS/EIR would still be necessary.

A Plan of Operations and associated rights-of-way applications for the Fort Cady Project have been submitted to the BLM pursuant to 43 Code of Federal Regulations (CFR) 3809 and 43 CFR 2800, respectively, and a Conditional Use Permit (CUP) application and reclamation plan have been submitted to the San Bernardino County Planning Department. These submittals commence the BLM and County review process, which is continued in their joint preparation of this EIS/EIR.

1.4.1 NOTICE OF PREPARATION AND NOTICE OF INTENT

On January 4, 1991, the County of San Bernardino distributed its Notice of Preparation (NOP) of a Joint EIS/EIR for the Fort Cady Project. This notice was sent to all Responsible and Trustee Agencies with potential project involvement, and requested that environmental information, questions and comments on the project be submitted within 30 days.

Responses to the NOP were received from the following agencies:

- California Regional Water Quality Control Board, Lahontan Region
- County of San Bernardino Department of Environmental Health Services
- State of California Department of Conservation, Division of Mines and Geology
- State of California Department of Transportation, District 8
- State of California Department of Fish and Game

The BLM published its Notice of Intent (NOI) to prepare an EIS for the Fort Cady Project in the *Federal Register* on May 10, 1991. The NOI also announced the dates and locations of the public scoping meetings scheduled in the project area.

1.4.2 PUBLIC SCOPING MEETINGS

As federal lead agency, the BLM sponsored three public scoping meetings in the Fort Cady project area. Meetings were held as follows:

May 30, 1991:	Newberry Springs, California
May 31, 1991:	Barstow, California
June 1, 1991:	San Bernardino, California

The BLM began each meeting by introducing the various project participants, describing the purpose of the scoping meetings, and explaining the agency's role and responsibilities for the EIS process. Representatives of San Bernardino County then explained the County process under CEQA and the requirements for approval of the Conditional Use Permit and Mining and Reclamation Plan. FCMC then provided a description of the project facilities and the in-situ mining process, and a brief background of the corporation. The major activities and milestones to be accomplished during the EIS/EIR process, and the anticipated schedule for those activities was discussed. At the conclusion of the presentations, comments and questions were solicited from the audience.

Responses to these opportunities for scoping input for the EIS/EIR focused on the following:

- Date when the project would be in operation
- Amount of land in use: has the land in the project area been acquired, and would all of it be needed for the mining operation
- Extent of drilling: would mineral resources beyond the surface perimeter of the project area be affected
- Potential for contamination from the evaporation ponds (now removed from the proposed action)
- Depth the injected acid would penetrate before it is neutralized

- Effects on desert tortoises and the potential for area land exchanges
- Air quality
- Dust problems
- Groundwater issues: usage; quality; existing level of the water table and replenishment of the aquifer; effects on local (Newberry Basin) water supply
- Project financial requirements and economic impacts
- Number of jobs created by the project

1.4.3 PREPARATION OF THE DRAFT EIS/EIR

This Draft EIS/EIR identifies and presents an analysis of the potential environmental impacts of the proposed action and alternatives to the proposed action.

1.4.4 NOTICE OF COMPLETION AND FEDERAL REGISTER PUBLICATION

An announcement that the completed Draft EIS/EIR is available will be distributed by the County in a Notice of Completion and by the BLM in the *Federal Register.*

1.4.5 RELEASE OF THE DRAFT EIS/EIR FOR PUBLIC REVIEW AND COMMENT

The Draft EIS/EIR will be released to the public, including interested individuals, groups, government representatives, and agencies, for 60 days.

1.4.6 PUBLIC HEARING

Two public hearings will be scheduled to be held during the review period of the Draft EIS/EIR. San Bernardino County will also have an Environmental Review Committee (ERC) meeting. These public hearings will provide the public with an opportunity to comment on the Draft EIS/EIR.

1.4.7 PREPARATION OF THE FINAL EIS/EIR (FEIS/EIR)

The Final EIS/EIR will respond to public comments on the Draft EIS/EIR.

1.4.8 NOTICE OF DETERMINATION AND RECORD OF DECISION

After publication and circulation of the Final EIS/EIR, a public hearing will be held by the County to consider certification of the Final EIS/EIR. The County will then make a final decision on the project, and will file a Notice of Determination. After coming to a decision on the proposed action, the BLM will publish a Record of Decision in the *Federal Register.*

1.5 MAJOR PERMITS, APPROVALS, CONSULTATIONS AND ACTIONS

Table 1.5-1 provides a summary of required project permits and approvals. These have been divided into permits and approvals required under federal, state, and County jurisdiction, and the requiring agency is presented, along with a description of the permits and approvals.

1.6 REPORTS CITED IN THIS DOCUMENT

Reports from published sources that are cited in this document are available in public libraries. Unpublished reports are available by mail for the cost of shipping and handling from: FCMC, 4443 National Trails Highway, Newberry Springs, CA 92365. Project-related hydrology, biology, and cultural resources reports are on file with, and available for review at, the BLM and County of San Bernardino.

TABLE 1.5-1

LIST OF PERMITS AND APPROVALS

Required Permit/Approval	Agency/Authority	Purpose
FEDERAL		
Plan of Operations	Bureau of Land Management	Mine and Reclamation Plan Approval
Cultural Resource Permit (Section 106, Consultation)	Bureau of Land Management, State Historic Preservation Office, National Advisory Council on Historic Preservation	Investigation to determine potential for National Register of Historic Places inclusion
Right-of-Way Grants and Notices to Proceed	Bureau of Land Management	Road and rail access, electric power, gas pipeline, and water line rights-of-way
Emergency Fire, Evacuation and Rescue Plans	Department of Labor, Mine Safety, and Health Administration	Plans required for surface operations
Notice of Start of Operations	Department of Labor, Mine Safety, and Health Administration	Notice must be filed for location and ownership
Legal Identity Report	Department of Labor, Mine Safety, and Health Administration	Report on type of operation, location and ownership
Record of Inspection of Self-Propelled Equipment	Department of Labor, Mine Safety, and Health Administration	Must be maintained for six months and available to inspectors
Record of Testing the Resistance of Electrical Ground System	Department of Labor, Mine Safety, and Health Administration	Test required annually and after installation, repair, or modification. Record of tests must be available to inspectors.
Biological Assessment and Habitat Conservation Plan (Section 7, Consultation)	Fish and Wildlife Service	Evaluate threatened and endangered species impacts.
STATE OF CALIFORNIA		
Waste Discharge Permit	Lahontan Regional Water Quality Control Board	Surface and groundwater quality control
Mine Waste Management	Lahontan Regional Water Quality Control Board	Classification of hazardous/non-hazardous waste and determination of geochemical behavior
Storm Water Permit	Lahontan Regional Water Quality Control Board	Control storm water runoff during construction
Dam Safety Permit	Department of Water Resources, Division of Safety of Dams	Certify gypsum pond dam structural/seismic requirements

TABLE 1.5-1
LIST OF PERMITS AND APPROVALS (continued)

Required Permit/Approval	Agency/Authority	Purpose
COUNTY OF SAN BERNARDINO		
Conditional Use Permit	San Bernardino County Planning Department	Consistency with planning/zoning; approval of proposed use
Grading Plan Approval	San Bernardino County Department of Building and Safety	Compliance with appropriate codes and standards
Building Plan Approval	San Bernardino County Department of Building and Safety	Compliance with appropriate codes and standards
Building Permits	San Bernardino County Department of Building and Safety	Fire safety, building safety, compliance with appropriate codes and standards
Approval of Mining/Reclamation Plan	San Bernardino County Planning Department	Satisfaction of SMARA requirements
Sewage Disposal System Permit	San Bernardino County Department of Environmental Health Services	Location, design, percolation rates for septic tanks and underground leaching fields
Water Well Permit and Inspection	San Bernardino County Department of Environmental Health Services	Documented locations and inspections of wells
Authority to Construct	San Bernardino County Air Pollution Control District (APCD)	Air pollution source location and control
Permits to Operate	San Bernardino County APCD	Air pollution emissions, monitoring, and reporting
Major Variance	San Bernardino County Planning Department	Consistency with planning/zoning; approval of proposed use

Section 2.0

Proposed Action and Alternatives

2.0 PROPOSED ACTION AND ALTERNATIVES

In early 1990, FCMC filed applications with the BLM and the County of San Bernardino for a mining project that proposed use of solar evaporation ponds for boric acid production. Pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969, the proposed action was reviewed to determine significance, as defined in 40 CFR 1508.27, with consideration of both content and intensity. The BLM completed the review in August 1990 and concluded that an EIS would be required for the project based on four of ten criteria. The finding included: the proposed action was the first of its kind and may be a precedent-setting method of subsurface mining; cumulative surface disturbance of 945 acres was 305 acres above the recommended threshold of 640 acres for the initiation of an EIS; the possibility of significantly impacting potentially important cultural resources; and lastly, potentially adversely affecting an endangered or threatened species or its habitat. The County of San Bernardino also determined that an EIR was required.

As a result of further project evaluation, the solar evaporation method was eliminated in late 1991 as not being state-of-the-art technology for environmental, technical, and economic reasons (see Section 2.6.1.2 for details). A combination of solution cooling and solvent extraction methods was selected as more suitable technology for the production of borates. The BLM decided that it was still appropriate to prepare an EIS for the changed project due to potentially significant biological and cultural resources considerations.

In late 1992, U.S. Fish and Wildlife Service (USFWS) issued a draft Biological Opinion for the proposed project. The Opinion was non-jeopardy but required that a proposed gypsum deposition area be relocated to reduce possible impact on desert tortoise habitat. A field visit was subsequently conducted by the BLM, USFWS, and Dames & Moore to identify a new location that would meet FCMC's technical requirements and be satisfactory to USFWS and the BLM. A new location was selected and is included as part of the currently proposed project.

The following sections provide background historical information on the project, a description of the currently proposed action, and a discussion of project alternatives.

2.1 HISTORY OF EXPLORATION AND MINING OPERATIONS

2.1.1 HISTORY OF EXPLORATION IN THE PROJECT AREA

Exploration and mining of hectorite clay in the project area has continued without interruption since the early 1930s. Rheox, Inc. currently operates a large open pit mine to recover high-grade hectorite clay approximately one-half mile southwest of the proposed Fort Cady ore body and well field. Less than two miles to the southeast of the project area, Kiewit Mining Group, Inc. (Pisgah Mining Operations; also called the Twin Mountain Mine), once mined a basaltic lava aggregate within Pisgah Crater; however, this mine is currently inactive.

The project region is known to contain several borate-bearing deposits, most notably deposits at Calico Mountain, deposits around Boron, California, and deposits found farther north, especially in and around Searles Lake, California.

2.1.2 INITIAL BORATE DISCOVERY

Initial discovery of the FCMC borate deposit occurred in 1964 when the Congdon and Carey Minerals Exploration Company found several zones of colemanite, a calcium borate mineral, between the depths of 1,330 and 1,570 feet below the surface in Section 26, T8N, R5E. In September 1977, Duval Corporation initiated land acquisition and exploration activities near Hector, California, and by March 1981 had completed 33 exploration holes in an approximately 800-foot drilling grid configuration on the project site. As a result of that drilling program, it was estimated that a borate ore body of sufficient size and grade existed to warrant further investigation.

2.1.3 FURTHER DEVELOPMENT

In 1981, Duval Corporation began conventional underground exploration. Because of the depth of the ore body, it appeared that underground mining methods would not be technically or economically feasible for use in its recovery. However, subsequent studies and tests indicated that in-situ technology could be a feasible method to employ in mining the FCMC colemanite ore body, and a pilot mining and processing operation was initiated in order to explore this possibility.

2.1.4 PILOT MINING AND PROCESSING OPERATIONS

Limited-scale mining on the project site was conducted by Duval Corporation from June 1981 to May 1982. Five wells and three small solar evaporation ponds were constructed, and 56,800 pounds of boric acid were recovered through the injection of approximately 80,000 gallons of hydrochloric and sulfuric acid leaching solution (injection solution).

An additional series of 11 pilot tests were conducted by Mountain States Mineral Enterprises, Inc. starting in July 1986. In these tests, dilute hydrochloric acid solution was injected through a single well into the formation, and boron-rich solution was withdrawn from the same well and discharged into evaporation ponds, where boric acid crystals were precipitated. In this manner, 106,000 pounds of boric acid were retrieved. To assess whether or not recrystallization would significantly improve product quality, a test processing plant was constructed. This plant consisted of a crystal slurry feed tank, a horizontal vacuum belt filter, a washed crystal storage bin, and boric acid dissolution, decant, and crystallization tanks for testing pond slurries.

2.1.5 PILOT ANCILLARY FACILITIES AND INFRASTRUCTURE

The Pilot-Commercial Plant (PCP) demonstration was initiated when FCMC became involved in the project. This allowed the company to evaluate, at pilot scale, the workings of the science and technology involved, develop details of design for the commercial facility, predict capital and operating costs, and evaluate environmental aspects of the process and facility. The PCP was in operation from July 1987 to March 1988. As part of the demonstration, its facilities included six production wells, evaporation ponds, and a processing plant. At this plant, 2.25 million gallons of injection solution were injected, and 903,300 pounds of boric acid were retrieved.

At the PCP, four additional solution wells were drilled. The operating system associated with the well field included the following: surface piping, sumps, a new rubber-lined steel storage tank for concentrated hydrochloric acid, and polyethylene storage tanks for mixing and dispensing injection solution. Dilute hydrochloric acid was pumped through fiberglass-reinforced pipes to the test wells during the injection test cycles. Each well was equipped with a recording flowmeter to record the amount of leaching solution injected. An airlift pumping system was used to recover the boron-rich solution: high pressure air was injected to the top of the formation through an airline, which reduced the specific gravity of the solution and caused it to rise to the surface.

The PCP included three evaporation ponds, the third constructed for surges or emergency storage. The three ponds used in the initial pilot mining operation were converted from storage of solution to storage of process water. Boric acid crystallized in the evaporation ponds and was then transferred to the PCP process plant.

The inactive PCP process plant is housed in a 1600 square foot building. In this plant, impurities, such as sand, dirt, and soluble impurities, were removed from the boric acid. Several unit operations were evaluated in the plant, including elutriation (purification by watering), filtration, dissolution, crystallization, regeneration, dewatering, and drying. The equipment types evaluated included a vacuum crystallizer, dewatering cyclones, horizontal vacuum belt filter, a centrifuge, and a tray dryer. Service facilities at the PCP included office trailers, acid and reagent storage areas, and an analytical laboratory.

2.2 PROPOSED ACTION

The proposed action consists of the construction and operation of a boric acid production mine and process plant with the capability of producing 90,000 tons per year of boric acid. The proposed facility would employ in-situ mining technology to mine an ore body containing colemanite, a boron-bearing, hydrous oxide ($Ca_2B_6O_{11} \bullet 5H_2O$) mineral. The recovery of boron from the colemanite mineral would be accomplished by injecting a weak acid solution (no more than five percent hydrochloric acid, sulfuric acid, or a mixture of both in a water solution) into the ore body. The acid would react with the alkaline nature of the ore body to recover a mixture of boric acid and calcium chloride, which would be dissolved in solution as products of the chemical reaction. This solution would be withdrawn from the well and pumped to the process plant where boric acid crystals would be precipitated. The remaining formation would be a porous matrix of clays and insoluble minerals. The void space that would result from the leaching process would constitute less than 12 percent of the formation, and the void space would ultimately contain water. Road and rail access, electric power, gas pipeline, and water line rights-of-way would be necessary for this project. All facilities would be designed to meet BLM and County specifications.

Four figures have been prepared to illustrate the project area and major project components. Figure 1.2-2 reflects the entire project; Figure 1.2-2a highlights the Process Plant/Access Road/Railroad Spur; Figures 1.2-2b shows the Gypsum Deposition Area/Slurry Pipeline; and Figure 1.2-2c identifies the water wells, water lines and Ore Body/Well Field.

2.2.1 MINING AND PROCESSING FACILITIES

The area of disturbance (i.e., the project site) resulting from the mining operation would consist of approximately 343 acres. Major components of the project would be the well field, the process plant (including cogeneration and electrical transmission facilities), and the gypsum deposition area. Ancillary items include a process water supply well network, a natural gas pipeline, a railroad spur, three access roads, and electric power facilities. The components are described in detail beginning in Section 2.2.1.1.

The acreage of the project site is presented in Table 2.2-1.

TABLE 2.2-1

ACRES DISTURBED AND RIGHT-OF-WAY INFORMATION FOR THE PROJECT SITE

Facility	Total Acres Disturbed	BLM Land				Private Land
		Acres Disturbed	Length of ROW	Width of ROW (feet)	Acres of ROW (Notices to Proceed required)	Acres Disturbed
Well Field, Including Access Roads	273	156	TBD	TBD	TBD	117
Process Plant/Co-Gen	10	NA	NA	NA	NA	10
Gypsum Depositional Area	16	NA	NA	NA	NA	16
Electrical Transmission Line	0[2]	0	7,280	25	4.1	—
Water Pipeline/Access Road	19.2	19.2	41,860	20[3]	19.2	—
Railroad Spur	7.6[3]	7.3	12,740	100	29.2	0.3
Natural Gas Pipeline	0[4]	0	10,306	25	5.9	—
Main Access Road	13.4[5]	12.5	7,280	125	20.9	0.9
Gypsum Deposition Service Road[6]	2.1	NA	NA	NA	NA	2.1
Well Field Service Road[6]	1.2	NA	NA	NA	NA	1.2
Total:	342.5	195	79,426	—	79.3	147.5

[1] Several of the facilities would not require rights-of-way, either because they would be placed on private land or because they are not the type of facility to which rights-of-way apply. These are designated by "NA" (not applicable), in the table above.

[2] The right-of-way for the electrical transmission line would occur within the 125-foot right-of-way for the access road; therefore, no additional land disturbance would result. The 125-foot right-of-way includes 75 feet for roadway, 25 feet for electric transmission line, and 25 feet for natural gas pipeline.

[3] Only 25 feet of the 100-foot-wide railroad right-of-way would be disturbed; hence, the disparity between the total right-of-way acreage versus the total disturbed acreage.

[4] The right-of-way for the natural gas pipeline would occur within the right-of-way for the access road; therefore, no additional land disturbance would result.

[5] Only 75 feet of the 125-foot right-of-way for access road would be disturbed; hence, the disparity between the total right-of-way acreage versus the total disturbed acreage.

[6] Does not occur on public land; therefore, rights-of-way are not required.

2.2.1.1 WELL FIELD FACILITIES

The well field area would disturb approximately 273 acres and would ultimately be comprised of up to approximately 200 wells. The well field configuration is depicted in Figure 2.2-1. Each well would be capable of operation in both the injection and recovery modes. Over time, as ore reserves are exhausted in specific localities, new wells would be drilled to replace those which are depleted.

Materials used for well casings would consist of 4.5- to 6-inch diameter fiberglass and/or plastic pipe installed to the top of the ore body at a depth of approximately 1,400 feet. The casing would be held in place by forcing cement down its center and up through the space between it and the drill hole bore. In the basalt area, if needed, wells would have a surface conductor of 10-inch steel tubing to maintain drilling mud circulation through the lava. Wells would be installed to conform with the regulations of San Bernardino County.

After the cement has set for at least two days, the well would be completed by drilling out the remaining cement in the casing and drilling through to the bottom of the ore. Underreaming to enlarge the well bore surface area may be employed to facilitate extraction. Each well would be equipped with a flow meter and pressure gauge.

The well field would be operated in a "push and pull" mode, whereby the injection solution would first be injected into the well and then allowed to remain in the formation for a period of four to 12 hours to facilitate its reaction with the ore body. The pH of a sample of solution withdrawn from the well would be tested, and if it is found to be low (i.e., the solution is still acidic), the injection solution would be left in the well for a longer period of time. Once the chemical reaction is thought to have reached equilibrium, the boron-rich solution would be recovered by use of submersible pumps and pumped to the processing plant. With this mode of operation, approximately one third of the wells would be in the injection mode, one third in the reaction mode, and the remaining third in the recovery mode.

The well field would be equipped with above-ground, eight-inch plastic trunk lines and a series of lateral collector lines to deliver injection solution and return recovery solution.

Roads would be constructed in the well field to facilitate access and periodic maintenance procedures. In areas overlain with basalt, roads would be constructed by placing fill dirt over the lava to allow access for the drilling rigs and service equipment.

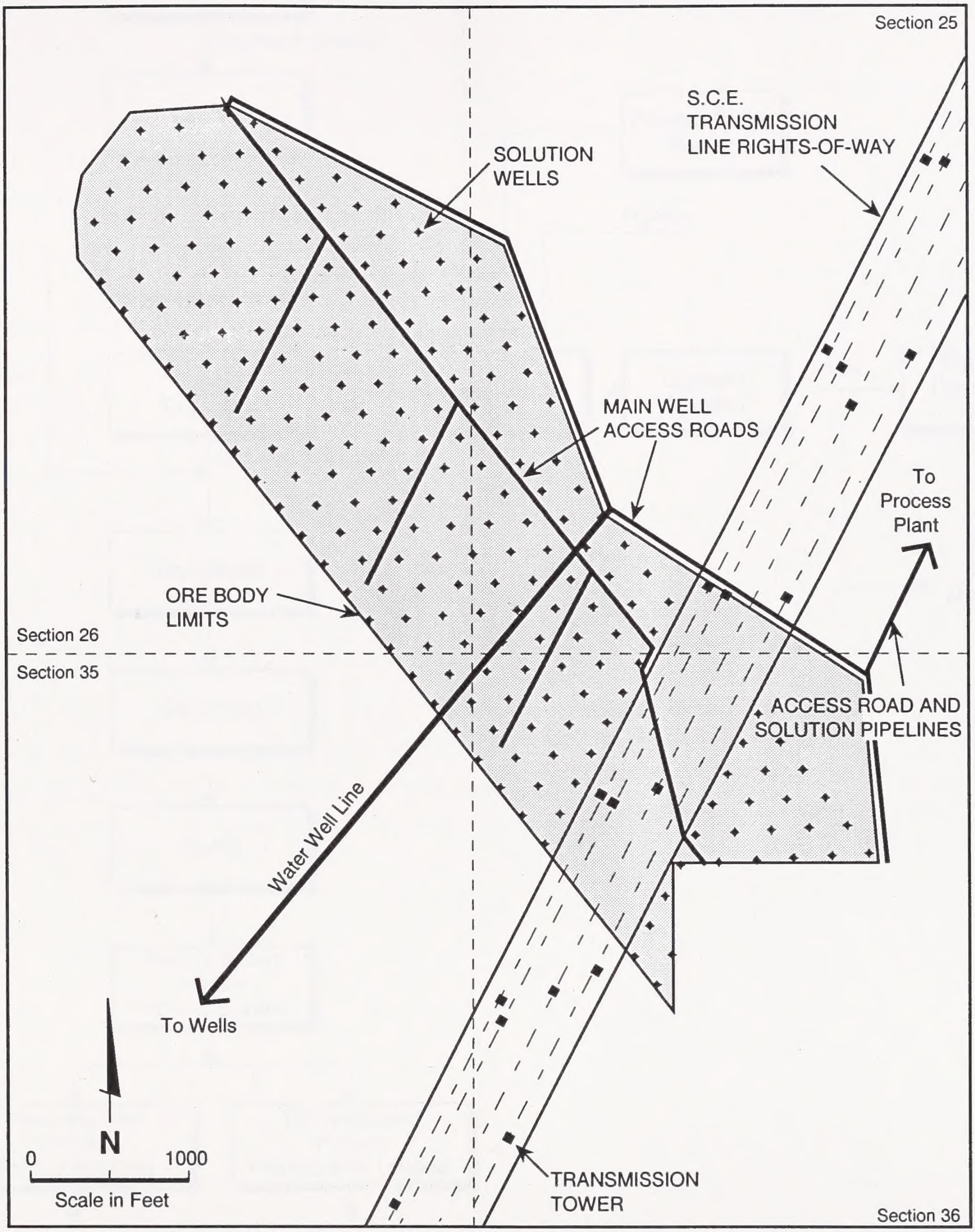
2.2.1.2 PROCESS PLANT FACILITIES

The process plant facilities would consist of: (1) a solvent extraction facility, (2) a purification/ crystallization facility, (3) a product loading and shipping facility, (4) acid regeneration and injection facility, (5) cogeneration facility, (6) ancillary services, and (7) process and storage tanks. The individual processing steps are detailed in Figure 2.2-2.

One building would be constructed on the project site on privately owned land. This building, the process plant, would contain the process facilities, staff offices, cogeneration facility, a maintenance shop, and a product loading and shipping facility. The process plant is anticipated to be an enclosed building 600 feet long by 400 feet wide, with portions of the building being 75 feet high. The southwest end of the building would have a 140-foot extension, which would hold the acid regeneration and injection facility. The northeast end would have a 200-foot concrete pad extension, which would hold the initial crystal recovery system and the solvent extraction facility.

SOLVENT EXTRACTION FACILITY

The solvent extraction unit would consist of up to six solvent extraction loading and six solvent extraction stripping cells. The loading and stripping cells would be identical and would consist of rectangular tanks approximately 15 feet wide by about 120 feet long, with a depth of about five feet. Each cell would be equipped with an electrical agitator. Auxiliary equipment would consist of carbon columns, pumps, surge tankage and necessary connecting piping. This equipment would be located on a cement pad extension northeast of the process building. The carbon in the carbon columns would require regeneration periodically. This would take place on site using elevated thermal regeneration. Thermal regeneration involves heating the carbon to at least 450°F, which expels the organic solvent from the carbon. The organic solvent expelled from the carbon would be condensed and reused in the process. Some of the carbon would be degenerated to dust, but this dust would ultimately be burned, and the fumes routed to the cogeneration boiler system, as explained in the APCD Permit To Construct application. The well field recovery solution would be continuously recycled through the loading cells, in which the boric acid would



NOTE: Ore Body limits fall within Township 8N and Range 5E.

WELL FIELD CONFIGURATION

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

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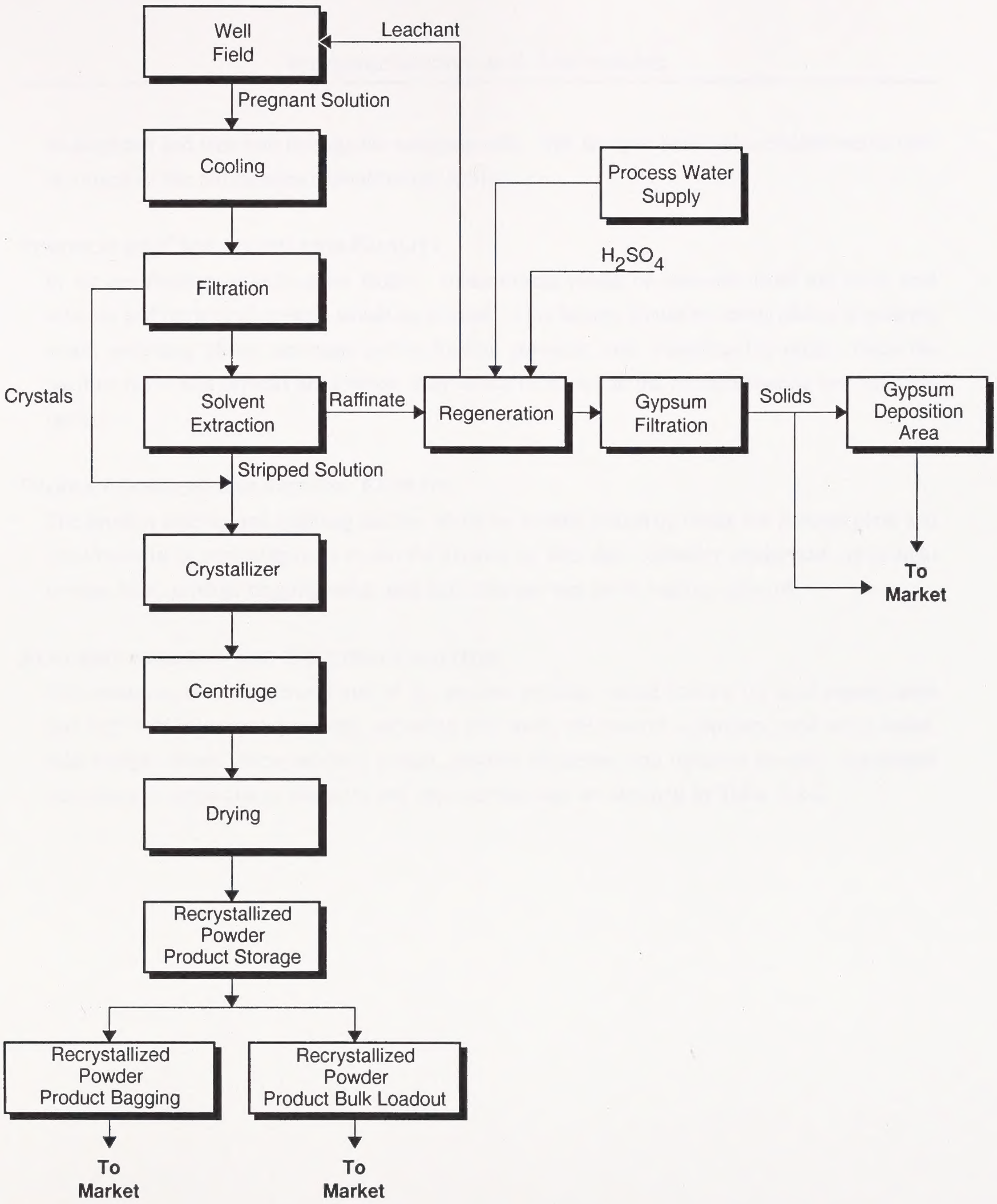
21864-001-001.WFC.1

FIGURE 2.2-1



OVERALL PROCESS FLOW DIAGRAM

Fort Cady EIS/EIR
Fort Cady Minerals Corporation
Newberry Springs, California

DAMES & MOORE

21864-001-001.OPFD

FIGURE 2.2-2

be extracted and then sent through the stripping cells. The stripped boric acid solution would then be routed to the purification/crystallization facility.

PURIFICATION/CRYSTALLIZATION FACILITY

In the purification/crystallization facility, contaminants would be removed from the boric acid solution and boric acid crystals would be formed. This facility would be comprised of dissolving tanks, polishing filters, activated carbon loading columns, and crystallization units. Once the purified boric acid crystals are formed, they would be routed to the product loading and shipping facility.

PRODUCT LOADING AND SHIPPING FACILITY

The product loading and shipping facility would be located primarily inside the process plant and would consist of screening units to sort the product by size, dust collection equipment, up to eight storage bins, product bagging units, and bulk railroad and truck loading systems.

ACID REGENERATION AND INJECTION FACILITIES

The extension at the southwest end of the process building would contain the acid regeneration and well field injection equipment, including mix tanks, pH control equipment, acid surge tanks, acid pumps, filters, slurry advance pumps, gypsum thickener, and injection pumps. Equipment descriptions, approximate numbers and approximate size are detailed in Table 2.2-2.

TABLE 2.2-2

Equipment Description	Approx. Number	Approximate Size
Acid regeneration tanks	5	10′ dia × 10 H
Belt filters	2	120 square feet
Filter repulp tank	2	6′ dia × 6′ H
Plate and frame filters	2	48" × 48" 45 chambers
Thickener	1	35′ dia 6′ H
Thickener over flow tank	1	12′ dia 12′ H
Thickener under flow tank	1	6′ dia 6′ H
Gypsum neutralization tank	2	6′ dia 6′ H
Injection tank	4	29′ dia 20′ H
Regenerated solution tank	1	22′ dia 22′ H
Hydrochloric acid storage tank	2	16′ dia 33′ H
Sulfuric acid storage tank	2	16′ dia 33′ H
Lime make up tank	1	12′ dia 12′ H

COGENERATION FACILITY AND ANCILLARY SERVICES

The primary source of electricity would be an on-site cogeneration facility; however, Southern California Edison Company (SCE) would provide back-up electrical supply. Electrical power would be available at all times to power the water supply pumps.

Because the process requires both electrical energy and heat, a cogeneration facility would be located in the main process plant. This facility would be made up of a four-kilowatt (kW) natural gas-fired turbine generator equipped with a waste heat recovery boiler, which would utilize the hot exhaust gases created during the burning of the natural gas. The waste heat recovery boiler would also be equipped with additional natural gas burners to increase steam capacity when necessary.

A natural gas-powered conventional generator set may be used in conjunction with the turbine to absorb the shifts in electrical demand. In addition, utility interconnection facilities would be provided to permit acceptance of power from SCE as needed, and the possible sale of surplus power to the utility in return.

A 1.3-mile electrical transmission line would extend from the existing transmission line along Pisgah Crater Road to the substation located at the process plant. This transmission line would be located within the same right-of-way as the main access road to the site. This line would be above-ground on standard pole configuration, and would be permitted, installed, and serviced by SCE.

Other ancillary items would include a main electrical substation and transformer area, a process and fire water storage area, and a natural gas station with meter. Process storage tanks would contain the fire protection and general process water supply, complete with pumps and various piping systems to deliver the water. An application for electric power right-of-way has been filed with the BLM in August of 1992.

Since process water is unsuitable for drinking purposes, up to approximately 150 gallons per day of bottled drinking water would be imported. Alternately, potable water may be purified from process water using purification/crystallization procedures. Sanitary sewage from the offices and process plant washroom areas, approximately 50 gallons per person per day, would be directed to a septic tank and tile bed system. The septic tank and tile bed system would be located adjacent to the northwest corner of the process building and would be approximately 100 feet × 200 feet in size.

PROCESS AND STORAGE TANKS

A process water surge tank would contain non-potable water for use at the process plant. This tank would be 40 feet high and 40 feet in diameter and would be equipped with two centrifugal pumps.

The majority of the process tanks (e.g., the solvent extraction loading cells, dissolving tanks, etc.) would be located at the process plant. Areas containing tanks would be located at both ends of the process plant on cement pads enclosed by cement berms. These bermed areas would be designed to contain process spill or storm water falling within the bermed area. Each bermed area would contain a below-grade sump equipped with a high-capacity pump and pipe manifold system capable of delivering the collected fluid to the desired location.

Storage tanks would be located near the process plant in non-permeable, berm-enclosed containment areas. These areas would be capable of holding 1.5 times the volume of the largest tank enclosed within them.

2.2.1.3 GYPSUM DEPOSITION AREA

Gypsum, a by-product of the boric acid mining operation, would be pumped in the form of a slurry from the process plant to the center of the gypsum deposition area. The water in which the gypsum will be pumped will be adjusted to a neutral pH. Neutralized water will percolate slowly out of the mounded deposit of gypsum and flow, via natural drainage patterns, to a low spot at the southern edge of the area. Water will be collected from this area and returned to the plant by a pump and pipeline system for reuse. This ponded area will be relatively small as water will be continually returned to the plant. Water loss is expected to be 60 to 80 gpm through evaporation and evapotranspiration due to the high average temperatures and prevailing wind patterns in the area. The minerals and salts in the water will be removed during the boron extraction; therefore, the quality of the water used in the slurry is expected to be high. Gypsum, a calcium sulfate compound, is virtually insoluble in water (L. Ordway, 1992) and a quantitative analysis of the leachate solution completed by WCAS found no metals approaching legal Resource Conservation and Recovery Act (RCRA) limits. Tables 2.2-3 and 2.2-4 show the results of chemical analysis of gypsum produced during pilot mining for CAM metals in TCLP leachate and total metals. These analyses indicate that the gypsum produced as a byproduct of the borate mining operation constitutes a non-hazardous product.

In the gypsum deposition area, gypsum would be impounded prior to being sold; i.e., to the local cement industry or the soil conditioning industry. Negotiations with interested purchasers are in progress. The gypsum deposition area would be approximately 16 acres in size and would include one dam constructed of in-place materials. The current location of the deposition area is based on requirements established by the U.S. Fish and Wildlife Service Biological Opinion for the Project, which is found in Appendix C of this document. The height of the dam would be no greater than 37 feet. Plastic liners would be placed on the side of the dams that would be in contact with the gypsum slurry and the dam would be constructed in accordance with California Division of Dam Safety requirements. No liner would be placed on the bottom of the deposition area. The Lahontan Regional Water Quality Control Board (RWQCB) has been requested by FCMC to grant a waiver for waste discharge requirements for the gypsum deposition area because the gypsum to be stored in the area is considered a saleable product rather than a waste.

TABLE 2.2-3
SUMMARY OF ANALYSIS OF CAM METALS IN TCLP LEACHATE

Metal	Detected Limits (mg/l)	RCRA Allowable Levels (mg/l)
Beryllium	0.003	—
Vanadium	0.008	—
Chromium	0.02	5
Cobalt	0.0026	—
Nickel	0.04	—
Copper	0.06	—
Zinc	0.022	—
Arsenic	0.055	5
Selenium	0.03	1
Molybdenum	0.186	—
Silver	0.001	5
Cadmium	0.004	1
Antimony	0.002	—
Barium	0.003	100
Mercury	0.003	0.2
Thallium	0.001	—
Lead	0.012	5

TABLE 2.2-4
SUMMARY OF ANALYSIS AS PER TITLE 22 OF THE CCR

Metal	Detected Limits (mg/kg)	TTLC Allowable Levels (mg/kg)
Antimony	0.4	500
Arsenic	1.2	500
Barium	1.0	10,000
Beryllium	0.04	75
Cadmium	0.28	100
Chromium	0.43	2,500
Cobalt	0.45	8,000
Copper	3.5	2,500
Lead	8.7	1,000
Mercury	0.06	20
Molybdenum	3.1	3,500
Nickel	4.1	2,000
Selenium	0.08	100
Silver	0.30	500
Thallium	7.6	700
Vanadium	0.46	2,400
Zinc	2.9	5,000

The gypsum slurry would be delivered via an above-ground pipeline (six inches in diameter) leading to the area from the process plant. Over time, the gypsum would settle, and water would be removed from the top of the pond and returned to the process plant via an above-ground water return pipeline. This pipeline would be four inches in diameter and approximately one-half mile long.

2.2.1.4 WATER SUPPLY WELL NETWORK

Approximately 150,000 gallons per day (or 0.46 acre feet per day, for a total of approximately 161 acre feet per year) of process water would be required for the proposed action in order to wash the gypsum produced, and for use in cooling, fire protection, and various sanitary uses.

The above-ground main water delivery line would have a diameter of three inches, and the above-ground delivery lines from the individual wells to this main delivery line would be three inches or less in diameter, depending upon the yield of the individual wells. Water lines would be constructed of either black plexed pipe or yellow-lined plastic. The distance from the farthest well to the process plant would be approximately eight miles. An application for the Federal Land Policy and Management Act Title V right-of-way for the water pipeline was filed with the BLM on July 9, 1990. The water well locations and transmission pipeline routes have been located on mill site claims HMS 1 through 128 and 130 through 474. These claims were filed with the BLM on September 18, 1989, and have been assigned California Mining Claim serial numbers 229645 through 230117.

2.2.1.5 RAILROAD SPUR, NATURAL GAS PIPELINE, AND ACCESS ROADS

The railroad spur is estimated to be approximately 2.4 miles long and would extend from the process plant to the Atchison Topeka and Santa Fe (AT&SF) Railroad line to the northeast of the project site.

The natural gas pipeline would be approximately two miles in length. The pipeline would be constructed between the process plant and the existing Pacific Gas and Electric Company (PG&E) main line. The tie-in would occur at the underpass of Pisgah Crater Road and I-40. The four-inch pipeline would be buried approximately 42 inches underground. It would parallel Pisgah Crater Road on the west side and follow the FCMC access road to the project site.

Access to the site would be from Interstate-40 to the Hector Interchange, east on National Trails Highway, south on Pisgah Crater Road (a paved road), and west on a FCMC access road. Three access roads would be constructed for the proposed action. Roads would be constructed of native material (i.e., not paved). The first would be approximately 1.4 miles long and 30 feet wide and would extend from Pisgah Crater Road to the process plant. Overhead transmission lines, a buried natural gas pipeline, and a railroad line would be constructed within the same right-of-way as the access road (Figure 2.2-3).

The second access road would be approximately one-half mile long and 20 feet wide and would extend from the process plant to the well field. Overhead transmission lines would also extend along this right-of-way. The pipelines for the injection of a weak acid and recovery of the boron-rich solution would also extend along this right-of-way. These above-ground pipelines would be constructed of plastic and/or fiberglass. Various temporary roads within the well field would be constructed in order to provide access for well, pipeline, and transmission line maintenance.

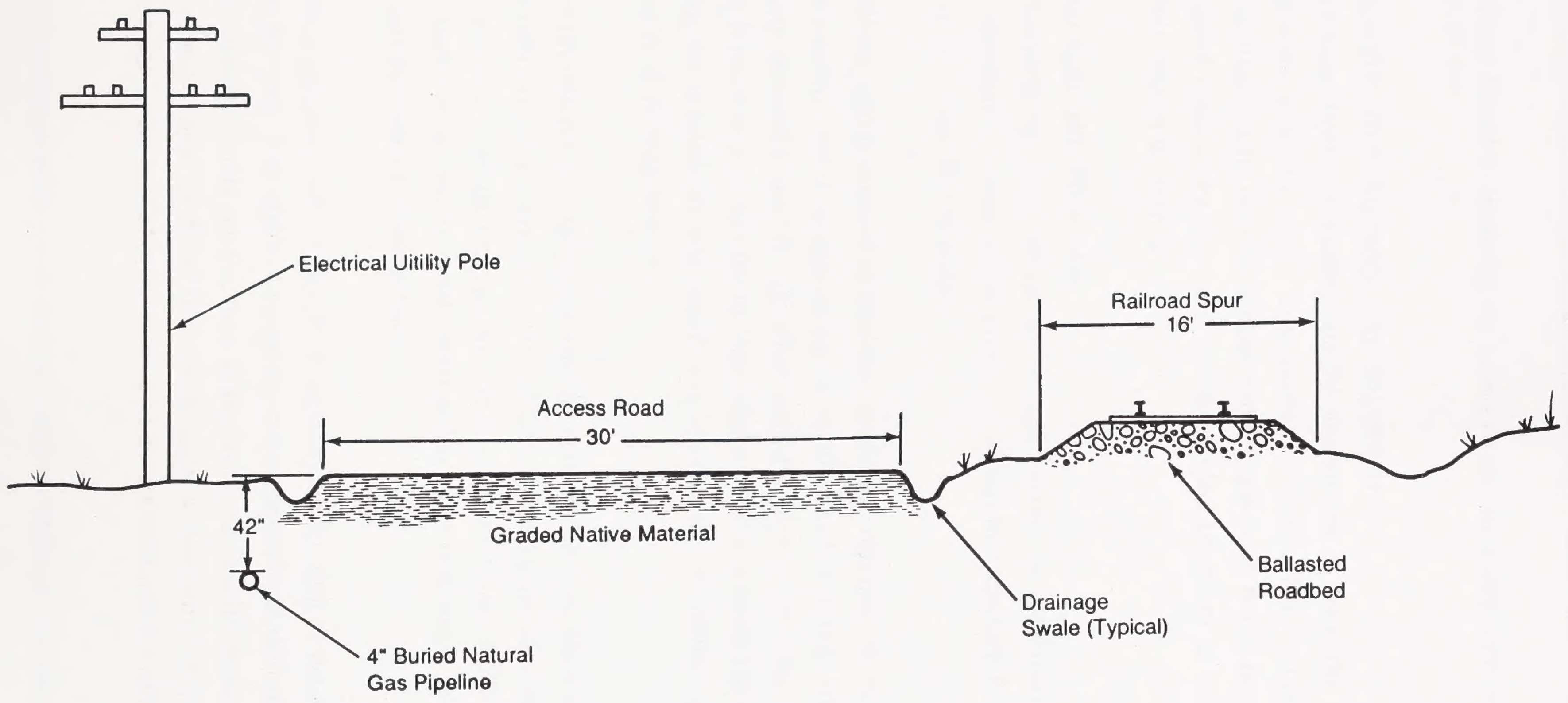
The third access road would extend from the process plant to the gypsum deposition area. This road would also be approximately one-half mile long and 20 feet wide. A plastic and/or fiberglass slurry delivery pipe, a plastic water return pipe, and a transmission line would extend along the same right-of-way. Applications for Federal Land Policy and Management Act Title V rights-of-way have been filed for the railroad spur and access roads, and for the natural gas pipeline in May 1991.

2.2.2 CONSTRUCTION OF MINING AND PROCESSING FACILITIES

Construction of the proposed action would commence when the necessary permits and authorizations have been obtained.

The major areas of construction would be the following:

1. A well field, which would include the process water supply network and associated road systems.
2. A processing plant, consisting of one consolidated building, including a processing section, offices, and a maintenance section.
3. A gypsum deposition area, which would include the slurry delivery and water return pipeline systems.



Not to Scale

CONCEPTUAL
ACCESS ROAD / RAILROAD SECTION
Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 2.2-3

DAMES & MOORE

21864-001-001.carrs

4. Ancillary facilities, including the access roads, the utility service delivery systems, and the railroad spur.

2.2.2.1 CONSTRUCTION METHODS AND EQUIPMENT

Site preparation, involving grading and the construction of the utility services, would take place at the beginning of construction. Construction of the well field and process plant would then be initiated simultaneously, once the access road is in place. A buffer zone of at least 300 feet would be maintained between mining wells and the project boundary to restrict mineral extraction to areas within project ownership.

WELL FIELD DRILLING PROGRAM

The well-drilling operation would be initiated during the construction phase of the proposed project. However, throughout the project, it would be necessary from time to time to replace existing wells within the ore body.

As a particular well is depleted of economic grade ore, replacement wells would be drilled. Wells would be shorter-lived if the underlying ore is not as rich as it is in other areas; if the underlying ore is more permeable than it is in other areas (in other words, the injection solution is able to penetrate it more rapidly and the ore becomes soluble at a faster rate); or if the thickness of the underlying ore is relatively less than it is in other areas. Maintenance problems can also lead to the necessity of drilling new wells.

The same procedures and equipment used for drilling domestic water wells would be used to drill wells into the ore body. Typically, the drilling equipment would consist of a 1500- to 2500-size drill rig, possibly a percussion type drill rig to penetrate basalt, a 580C Case or similar size tire-mounted backhoe, an approximately 3000-gallon water tank truck, and one or two pickup trucks for tool and personnel transportation.

The drilling equipment would first be brought to the location of the well to be drilled. If basalt underlies the area, a special tool mounted on the conventional drill rig or alternately, depending upon the number of wells and thickness of the lava layer, a drill rig designed for basalt penetration would be used. Once the basalt is bored through, a rotary drill would be used to drill the well. Drill locations in the basalt would require an access road and a small drill pad area.

If gravel or porous lava is present at the well location, a 24-inch steel surface conductor pipe would be placed into the well boring and, if necessary, a cemented well collar would be constructed around it. The surface conductor pipe would be used only in the upper sections of the well in order to maintain drill fluid circulation. All regulations and suggested procedures of the Environmental Health Services Department of San Bernardino County would be followed.

The underlying rock types that the well bore would penetrate are listed in Table 2.2-5.

TYPICAL WELL DRILLING SEQUENCE

The actual well drilling sequence is designed to be completed as simply as possible using standard drill bit and casing sizes. The basic procedure for drilling and completing a well is as follows:

1. Hammer drill 11-inch hole to bottom of basalt (if basalt is present).
2. Set and cement in place 8⅝-inch steel casing (if the well collar is needed).
3. Drill 7⅞-inch hole approximately 1400 feet deep and run geophysical logs to determine hole drilling quality and identify geologic conditions.
4. Set and cement in place 4.33-inch (ID) fiberglass casing.
5. Let cement set for at least 48 hours.
6. Drill out cement and drill to bottom of ore zone of approximately 1500 feet with 4¼-inch bit.
7. Flush and clean hole.

Table 2.2-5

TYPICAL LITHOLOGIC DESCRIPTION

0′ - 90′	Olivine basalt
90′ - 700′	Mudstone and sandstone
700′ - 1200′	Mudstone; minor tuffs
1200′ - 1275′	Mudstone; anhydrite; celestite; minor limestone and tuffs
1275′ - 1480′	Colemanitic, howlitic, and celestitic mudstone and anhydrite; limestone; tuffs
1480′ - 1520′	Anhydrite and mudstone; tuffs; minor howlite, limestone, and celestite
1520′ - 1690′	Mudstone and sandstone; mudstone with anhydrite; limestone and celestite; minor tuffs

Approximately seven days would be required to complete each well bore.

Construction of the well field would require up to seven drill rigs and ancillary equipment (i.e., back-hoes and water trucks). It is anticipated that each drilling rig would have a three person crew. Three to five of the drill rigs would typically be involved in drilling the production wells while the remaining two to four rigs would complete the construction of the wells (i.e., drill out cement, flush and clean the hole, etc.). However, if production wells are not available for completion, the remaining rigs would also be employed in drilling wells. Approximately three delivery trucks containing mud, casing, cement, and drill bits are expected to arrive weekly during the construction of the well field. A discussion of truck traffic associated with the construction of the proposed action is presented in Section 4.1.8.2.

CONSTRUCTION OF THE PROCESS PLANT AND GYPSUM DEPOSITION AREA

Construction of the process plant would require an average of 25 full-time employees. It is anticipated that the processing facilities within the building would be constructed prior to the construction of the office and maintenance facilities. The building would be constructed, equipment installation would take place, and facilities would be connected and hydrochecked to see that they operate properly.

The gypsum deposition area would be constructed after initial site preparation is completed and the well field and processing plant construction crews are engaged. Approximately 10 construction employees are expected to require one month to complete construction of the gypsum deposition area. The slurry delivery line, interceptor ditch, and water return lines to and from the gypsum deposition area would be among the last facilities to be installed before start-up.

CONSTRUCTION OF THE PROCESS WATER SUPPLY WELL NETWORK

Installation of the process water supply well network would follow the procedures described for the well field drilling program above. Similar equipment and crew size would be used to drill and complete the water wells.

Two of the process water supply wells already exist (in the southeast and the northwest corners of section 34), having been installed during the earlier pilot plant testing period. Additional wells would be drilled as they are needed and up to seven wells may be in operation at any given time during production, depending upon the process water demand and the individual well yield. If a process water supply well fails to produce the required water volume, another well would be drilled nearby to replace the depleted well.

Each well would be equipped with a pump and water delivery pipe joining the main water delivery line which leads to the process water surge tank located in the process plant.

The well field construction crew would install the process water network to connect the well field with the process plant as one of its first tasks to provide an ample supply of process (non-potable) water to mix with drill mud for use in well drilling.

CONSTRUCTION OF THE RAILROAD SPUR, NATURAL GAS PIPELINE, AND ACCESS ROAD

The main access road would be one of the first of the facilities to be completed. It would be constructed of base materials and gravel and would require eight construction workers and one month to complete. The railroad spur would be constructed according to AT&SF specifications by a railroad contractor and engineering firm hired by FCMC. The natural gas pipeline would be constructed by PG&E.

2.2.2.2 CONSTRUCTION WASTES

The proposed action would generate small volumes of solid and liquid wastes during construction. Wastes would be stored, recycled, or disposed of in accordance with the rules and regulations of the appropriate regulatory agency. Domestic garbage would be hauled to the County landfill facility. Hazardous wastes would be limited to spent motor oil, which would be hauled by a licensed hauler with appropriate manifest records being maintained. Types of waste anticipated are presented in Table 2.2-6. Acids are not considered waste because they would be recycled through the system on a continuous basis.

2.2.2.3 CONSTRUCTION WORK FORCE, SCHEDULE, AND COSTS

Construction of the proposed action would require a maximum of 76 employees at any one time and nine months to complete. This would entail labor costs of approximately $3,510,000. Construction would be scheduled for normal business hours, therefore without premium pay, as much as possible. However, due to the extreme afternoon temperatures during the summer months in this area, early morning hours may be substituted.

TABLE 2.2-6
ANTICIPATED PROJECT WASTE TYPES

Waste Type	Source Material	Disposal Procedure
Domestic waste	Paper, plastic, glass, foods	San Bernardino County Landfill
Industrial (non-hazardous)	Concrete, plastic/fiberglass pipe	San Bernardino County Landfill
Industrial (hazardous)	Spent oil	Licensed recycler

2.2.3 OPERATION OF THE PROPOSED ACTION

2.2.3.1 OPERATION OF THE MINING PROCESS AND THE PROCESSING FACILITIES

Due to the difficulty and extensive time necessary for start-up and shut-down of the integrated process, operations would be continued 24 hours a day, seven days a week, 365 days per year. This continuous operation is anticipated for both the well field and the process plant.

The well field may be operated in a continuous manner, with acid solution being injected into some of the wells while boron-rich solution is recovered from other wells. During mining operations, control of the injection of the leaching solution would be maintained via valves and pumps on the injection manifold. The valves may be controlled either automatically from the process plant area or manually at the well location. Each well would be programmed for a certain volume of injection fluid (depending upon conditions described in Section 2.2.2.1 above) and monitored to ensure that the correct amount is injected. After the injection solution has remained in a particular well for the optimal amount of time (typically four to 12 hours), the boron-rich solution would be recovered and pumped to the process plant. This would be controlled by the operation of valves and pumps located on the recovery manifold. As with the injection manifold, the valves and pumps may be controlled either from the process plant or manually at the well location. All pipes are located on the surface. Pipes would be routinely visually inspected for leakage, and the pressure gauges would be monitored for pressure declines.

Typically, each crew would have one or two operators assigned to the well field to patrol the area and ensure that all equipment is functioning properly, that injection and recovery at each well is being managed correctly, and a "balanced" well field is in operation. A balanced well field exists when a similar amount of solution is being injected as is being recovered. Ideally, slightly more solution is recovered than injected: this positive balance ensures that a small influx of water is maintained throughout the well field, which protects against potential seepage of injection fluid out of the well field. Excess water would be evaporated in the gypsum deposition area.

A process flow diagram is presented as Figure 2.2-2. The major operating supplies used in the process are detailed in Table 2.2-7. Table 2.2-7 is based on the anticipated production of 90,000 tons of boric acid and 86,000 tons of gypsum per year.

TABLE 2.2-7

MAJOR OPERATING SUPPLIES

Item	Estimated Consumption	Delivery/ Storing
Hydrochloric acid	9400 tons/yr	Railcar/bulk - 2 tanks
Sulfuric acid	50,000 tons/yr	Railcar/bulk - 2 tanks
Lime	2000 tons/yr	Truck/bulk - 1 silo
Natural gas	435,000 mcf/yr	Gas pipeline
Process water	161 acre feet/year (~100 gpm)	Wells/pipeline/bulk tank
Isooctanol	265 tons/yr	Truck/bulk - silo
Kerosene	90 tons/yr	Truck/bulk - silo

SOLVENT EXTRACTION

The boron-rich well field recovery solution would be routed to the solvent extraction facility, where the recovered boron would be concentrated. The solvent extraction facility would include cooling equipment, filters, surge tanks, and solvent mixers and settlers. The small amount of non-hazardous filtered material collected would be sent to an approved landfill. The solution would be sent through the cooling equipment, which would be made up of a heat exchanger cooled by recycled water from a cooling tower. Recycled water is included in the calculation of water demand of approximately 100 gpm for the proposed project. This cooling would adjust the solution temperature and allow the excess boric acid to precipitate. The resulting boron-rich aqueous slurry would then be conducted through a series of filters and placed in solvent extraction surge tanks.

From the surge tanks, the boron-rich slurry would be pumped to a series of solvent mix tanks and settler basins. The mixing chamber would be equipped with an electrical agitator which would thoroughly blend the organic solvent, a mixture of isooctanol and kerosene, with the boron-rich slurry. During this mixing, the boron attaches itself to the solvent. The mixed fluid would then flow into the settling chamber where the boron-rich organic solvent, being lighter than water, would float to the top.

The boron-rich solvent would be skimmed from the top of the aqueous solution and would be directed next to the stripping facility. Here, boron would be removed from the organic solvent using water or a weak (approximately five percent) acid solution.

After stripping, the solvent would be returned to the loading cells in the stripping facility and the process would continue in a continuous mode. The concentrated boric acid solution would then be routed to the purification/crystallization and product loading facilities. The well field solution, from which the boric acid has been removed, would be routed to the acid regeneration facility, from there it would be reinjected into the well field for further boron recovery.

The various plant facilities would operate more or less simultaneously. Operating instructions would be disseminated by management, and supervision would exist at the various plant facilities in order to maintain proper operational conditions. Where possible, process criteria would be monitored by computer, and alarms would be triggered if operating limits are exceeded. Visual inspection for dripping and slow leaks would also take place. Solvent mixing tanks, settling tanks, and vessels would be covered and the vapors vented to the cogeneration plant (waste heat boiler) for incineration.

PURIFICATION/CRYSTALLIZATION

The boric acid solution produced in the stripping facility would be crystallized in the purification/crystallization facility in order to separate the boric acid from the solution. The barren solution would then be rerouted back to the stripping cells of the solvent extraction section for additional stripping.

The boron-rich solution emerging from the stripping section would be a purified boric acid solution, which would be sent to the crystallization unit. Here, the solution would be cooled using vacuum crystallization technology, and the result would be a pure product of boric acid crystals. The particulate impurities would be either returned to the acid regeneration facility or routed to the gypsum deposition area, depending upon the relative solubility of the material.

If the level of impurities is low in the concentrated boric acid solution, and a market for a less pure boric acid product exists, the crude boric acid crystals may be conveyed directly to the product drying and shipping section, bypassing the purification/crystallization process.

ACID REGENERATION AND INJECTION

The solution recovered from the well would contain both boric acid and calcium chloride as products of the chemical reaction between the injected acid and the colemanite ore. The solution remaining after the boron product has been removed in the solvent extraction facility would be rich in calcium chloride and would be pumped to the acid regeneration facility. This facility would contain mixing tanks, pH control equipment, acid surge tanks, acid pumps, filters, slurry advance pumps, and injection pumps. The pH control equipment would consist of a lime adjustment system, which would consist of a dry bulk lime storage silo with vent filter, and a lime slurry preparation and addition system. This equipment would be used intermittently, as required.

The calcium chloride-rich solution would first enter the acid regeneration mix tanks, where the solution would be agitated and mixed with sulfuric acid. The calcium chloride would react with the sulfuric acid and form hydrochloric acid and gypsum (calcium sulfate). If an insufficient amount of sulfuric acid is added at this stage, the resulting solution would contain a mixture of hydrochloric acid and unreacted calcium chloride. If this solution were to be injected into the ore body, insufficient leaching would result, due to the inability of calcium chloride to react with colemanite ore. Therefore, an excess of sulfuric acid is added in the acid regeneration mix tanks to facilitate complete reaction of the calcium chloride with the sulfuric acid.

The injection solution would contain a mixture of no greater than five percent sulfuric and hydrochloric acid, the quantities of which would vary, depending upon the amount of calcium chloride contained in the recycled well field solution (from which the boric acid has been removed). Hydrochloric acid may be added to the recycled well field solution when insufficient calcium chloride is present, thereby creating a refortified injection solution strong enough for efficient underground leaching.

The refortified leaching solution would be injected into the ore body by use of injection pumps. The solution would then be left in the ore body for a period of time to allow for the chemical reaction to occur. After approximately four to 12 hours, depending upon the size and composition of the ore reserves underlying the well, the boron-rich solution would be removed from the ore body and the entire process repeated as described above.

PRODUCT LOADING AND SHIPPING

In the product loading and shipping facility, the boric acid crystals would be sent first to the centrifuge, where the majority of the water would be removed. From the centrifuge, they would be conveyed to the natural gas-fired dryer, which would remove the remaining moisture. The product dryer maximum head input is 11 MMBTU/hr. When the product is dry, it would be sorted by size through the use of sizing screens. The dried and screened boric acid crystals would then be delivered to a bagging system which would produce 80- or 100-pound bags of shrink-wrapped product. Typically, the filled bags are placed on pallets within the process plant and can be loaded onto trucks or railroad cars using fork lifts and conveyor equipment. Alternately, the product can be routed to bulk loading dock facilities, from which bulk trucks or railroad cars can be loaded.

Equipment within the product loading and shipping facility that may produce dust emissions would be outfitted with high-efficiency dust collection equipment specifically designed to meet the emission specifications of the San Bernardino County Air Pollution Control District (SBCAPCD). An ongoing maintenance program would govern the proper operation of the dust prevention units.

GYPSUM PRODUCT

As described above in Section 2.2.1.3, gypsum would be stored in the gypsum deposition area prior to being sold, for example, to the cement or soil conditioning industries.

YEARS OF PRODUCTION

The estimated size of the ore reserve is approximately 9,392,000 tons. The boric acid product makes up 6.11 percent of this ore. Therefore, at an annual production rate of 90,000 tons of boric acid, the ore would be consumed at a rate of 50,670 tons per year. At this rate, and assuming that approximately 70 percent of the ore body would be recoverable, sufficient reserves exist to allow for approximately 130 years of boric acid production.

2.2.3.2 OPERATIONAL WASTES

Wastes generated by the operation of the process plant would include domestic garbage and used engine oil, grease, and solvents. As described above in Section 2.2.2.2, the domestic garbage would be collected in a five-yard dumpster on site and removed off-site by a contractor once per week to the Barstow landfill. Oil (including that from the cogeneration facility), grease, and solvents would be removed from the project site to an approved recycling depot and hazardous waste facility. No hazardous wastes are generated by the process operation other than waste oil resulting from changing lubricating oil from the cogeneration unit. This waste oil would be hauled by a licensed recycler (see Table 2.2-6) for recycle.

2.2.3.3 UTILITY REQUIREMENTS

PROCESS UTILITY REQUIREMENTS

Approximately 435,100 cubic feet of natural gas would be used by the proposed action per year. This gas would be supplied by PG&E and would require the facilities described in Section 2.2.1.5. Approximately four megawatts (MW) of electrical power would be used by the proposed action. A cogeneration facility would be on site to provide the bulk of this power. However, Southern California Edison (SCE) would provide a portion of the power, especially during construction, during periods of FCMC major generator maintenance, and during periods of low power demands. The electrical power mix between SCE-supplied power and cogenerated power would be dependent upon process requirements, process operating conditions, and especially the cost of SCE- versus FCMC-generated electricity. If excess electrical energy is available at the production facility, it could be sold to SCE. The Waste Heat Boiler supplemental firing would be operated at all times to incinerate solvent vapors from the solvent recovery vessels. The supplemental firing would require a minimum of 1 MMBTU/hr to a maximum of 4 MMBTU/hr.

SECURITY AND LIGHTING

Directed, overhead lighting would be installed in the well field, gypsum deposition area, along pipelines, and around the process plant. These would be sodium halide lights designed to reduce glare. These lights would be equipped with on/off switches so that if illumination was not required, power could be conserved.

Roads leading to the area would be equipped with gates, and access to the mining area and process plant would be restricted to employees, authorized visitors, and delivery trucks. Visitors would be required to stop at the office to gain authorization before proceeding. In most cases, visitors would be escorted on-site by FCMC personnel. During non-standard duty hours, access would be restricted to management personnel and authorized employees.

2.2.3.4 WORK FORCE, HOURS OF OPERATION, AND COST

Approximately 80 full-time employees, made up of salaried staff and operating staff, would be required for operation of the proposed action. As opposed to salaried staff, operating staff would be paid per hour worked. Table 2.2-8 provides a summary of the positions and number of employees per position anticipated. Four individual crews would be designated as shift personnel. Each of the four crews would be supervised by a foreman with complete responsibility for the facility during non-standard duty times. At any given time, one of the four crews would be on duty, one would have just worked the preceding shift, one would be scheduled for the following shift, and one would be on break. Each crew would work eight-hour shifts. The shift crews would be responsible for the continuous operation of the well field and processing plant.

The remaining personnel would be scheduled for normal duty hours. The day crew would be responsible for the non-routine tasks and jobs that can be completed during normal business hours, such as visitor reception, overall facility management, large maintenance items, etc.

Employees are expected to live primarily in Barstow, Newberry Springs, or Ludlow, California. Employee traffic is estimated to be approximately 130 vehicles trips per day.

2.2.3.5 ACCIDENT PREVENTION AND FIRE PROTECTION

ACCIDENT PREVENTION

An accident could occur during operation of the proposed action as a result of an uncontrolled release of fluids to the environment either from a ruptured or overfilled holding tank or a ruptured hose or pipeline.

Since tanks holding the various process solutions would be contained within bermed areas equipped with sump pumps, in the unlikely event of a tank rupturing or overfilling, process solutions are unlikely to be released to the environment.

TABLE 2.2-8

Salaried Staff.

Title	Number
Resident Manager	1
Secretary/Receptionist	1
Chief Accountant	1
Payroll Supervisor	1
Purchasing Agent	1
Warehouse Attendant	2
Traffic Manager	1
Production Manager	1
Secretary	1
Loadout/Surface Supervisor	1
Shift Supervisor	4
Chemical Engineer	1
Chief Chemist	1
Analysts	4
Service Manager	1
Maintenance Planner	1
Security/First Aid Attendants	4
Plant Maintenance Supervisor	1
Well Field Maintenance Supervisor	1
Well Field Engineer	1
TOTAL	30

Total annual cost for salaried staff: $1,510,000

Operating Staff.

Title	Number
Electrical/Instrumentation	4
Mechanics	4
Pipefitters	4
Welders	1
Mechanic Helpers	4
Well Field Operators	8
Crystallizer Operators	4
Helpers	8
Baggers	2
Loadout Helpers	2
Loadout/Surface Laborers	4
TOTALS	49

Total annual cost for operating staff: $2,000,000

A pipeline rupture would be immediately recognized in the process plant control room, since a sharp change in pressure and the rate of flow within the pipeline would result. Alarm systems would be activated (either by computer or by process plant staff), and pump operation would be halted until the pipeline was repaired. As an added precaution, operator patrols would visually monitor the process equipment regularly.

If, despite precautions, an accidental release does occur, the operation of the effected facility would be halted and appropriate regulatory authorities notified. The area would be cleaned up using appropriate procedures based on the type of material spilled, and the defective equipment would be repaired or replaced. A report of the incident would also be prepared and reviewed by site maintenance personnel and management as part of an ongoing accident prevention program.

A Hazardous Materials Handling Permit (#9202240012) and Business Plan have been obtained for the proposed action.

Hydrochloric acid and sulfuric acid would be transported to the project site by truck during initial project start-up, and after completion of the rail spur, by railcar. This is a fairly common mode for bulk transport and the anticipated risk of an accident is considered low. Spent oil from on-site operations would be transported by truck to a licensed recycler. Shipment of hazardous materials must be in compliance with Department of Transportation regulations, which govern the necessary proactive precautions for transport. These regulations include specific criteria for holding vessels; require the placement of safety devices such as isolation valves on certain locations of truck or railcar piping; and require safety placards indicating the type of materials in transport. Adherence to these regulations, coupled with proper speed, would minimize the traffic accident potential and health risk to receptors.

FIRE PROTECTION

The site is located approximately 20 miles from the Newberry Fire Station. The response time is estimated to be less than 25 minutes, since the majority of the route traveled between the fire station and the project site would be along Interstate-40.

In the case of an emergency, water from the process water surge tank could be used for fire control. In addition, fire hose connections would be installed on the water supply pipeline. Fire hose storage stations would be placed throughout the process plant. Automatic control of the filling of the process water surge tank would ensure that it is always full.

2.2.4 SITE CLOSURE AND POST CLOSURE

Given the size of the colemanite ore body, site closure is anticipated to occur over one hundred years after mine start-up. The estimated time to complete final reclamation is 18 months. Disturbed areas would be recontoured and stockpiled soils would be redistributed to allow for the reestablishment of vegetation. Due to the anticipated longevity of the mining operation, the reclamation plan for the proposed action would need to be updated to accommodate changes in agency requirements. The reclamation plan would probably be updated as other project permits are updated.

There would be three primary areas of disturbance on the site, including (1) the well field, (2) the process plant, and (3) the gypsum deposition area. The closure procedures for each of these areas are described below.

2.2.4.1 WELL FIELD FACILITIES

The well field would be closed by first filling the bottom of the wells with a cement plug. Approximately ten feet below the surface additional plugs would be installed. The concrete and casing within the wells would be cut approximately two feet below the surface and the top portion hauled to an approved landfill. The surface would then be graded to blend with the surrounding relief and a revegetation program initiated.

The pipelines would be washed (by flushing with circulating water), dismantled, and transported to the process plant for sale as salvage material. The roads on the well field would be restored and scarified by grading to match the surrounding relief.

2.2.4.2 PROCESS PLANT FACILITIES

The process plant would be closed approximately six months after the well field is closed. Equipment, including chemical process equipment, laboratory apparatus maintenance tools, buildings, pipe, etc. would be sold as salvage and/or removed from the site to be used on other projects. Disposal of concrete and other waste material would be in accordance with applicable regulations at the time of closure.

2.2.4.3 GYPSUM DEPOSITION AREA

Any gypsum remaining in the gypsum deposition area would be collected. The downstream slope of the gypsum deposition area would be covered with riprap in order to control erosion. A layer of fill would be placed over the disturbed area and graded to blend with the surrounding relief. This fill would be obtained from surface materials from areas that have been previously surveyed for the proposed project. A revegetation program would then be initiated.

2.2.4.4 PROCESS WATER SUPPLY WELL NETWORK

Procedures for the closure of the process water supply well network would be similar to those for the closure of the well field. The water supply wells would be plugged in accordance with regulatory requirements, and the well casing would be cut off approximately two feet below the surface. The surface would be graded to blend with the surrounding topography. The water delivery lines would be disassembled and sold as salvage pipe.

2.2.4.5 RAILROAD SPUR AND ACCESS ROADS

Access roads would be graded to blend with the surrounding area and scarified to facilitate revegetation.

Track ties and rock ballast from the railroad spur would be removed and sold as surplus material, and the railroad bed would be recontoured and scarified to blend with the surrounding terrain. Any contaminated soil would be treated as necessary and recontoured to blend with the surrounding terrain, or removed and disposed of in an appropriate facility.

2.2.4.6 POST CLOSURE

Following closure of the facility, the site would be allowed to revert to desert conditions similar to those now in existence. No impact on the adjacent hectorite and cinder mining operations is expected.

The reclamation plan for the proposed action would be revised to address project changes and would conform with the reclamation requirements of the BLM (as presented in the BLM Solid Minerals Reclamation Handbook H-3042-1); the County of San Bernardino; and the California Office of Mines and Geology.

2.2.5 ENVIRONMENTAL PROTECTION MEASURES

Numerous environmental protection measures would be employed during the construction and operation phases of the proposed action. A number of these measures would be implemented in day-to-day operations throughout the lifetime of the project. The environmental protection measures described below are broken into three major categories, those associated with construction, with system designs, and with operational procedures.

2.2.5.1 CONSTRUCTION

Each construction crew would be briefed on the sensitive aspects of the particular area in which they are working. The following are examples of briefings to be given and precautions to be taken:

1. For work conducted outside, including, but not necessarily limited to site preparation crews, well field drilling crews, and gypsum deposition area construction crews, briefings would be given and workers supervised on required procedures to be followed should desert tortoises be encountered.

2. Project personnel would be instructed to avoid sites with known cultural resources. Additionally, personnel would also be instructed to avoid disturbing cultural artifacts encountered in the project area. Should unknown cultural features be found during the course of work within the project area, work would cease at the site of discovery until mitigation measures can be taken.

3. Each construction crew would be briefed on, and supervised with respect to maintenance precautions involving spilled diesel and motor oil and other hazardous construction materials.

4. Trash removal at construction sites would be supervised with the goal of not allowing trash to accumulate and not providing an opportunity for trash to blow away or otherwise become scattered.

5. Access roads would be watered periodically to control dust.

6. The area of disturbance would be minimized.

Federal, State and County regulations would be strictly adhered to.

2.2.5.2 SYSTEM DESIGNS

Numerous systems have been designed into the facility to reduce environmental impacts, including the following:

1. The solvent extraction facility would be designed with a suction fan and a venting duct system to capture fumes. Fumes would be absorbed in an activated charcoal system. The absorbed material would be removed periodically from the charcoal using steam purging techniques, and the removed material would be cycled back to the extraction system and reused.

2. Various dust bagging and particulate filters would be placed on the product silos and similar areas from which dust may escape. These devices would be cleaned periodically and the captured dust cycled back to the product bins.

3. Since the cooling tower and steam boiler blowdown fluid would not contain contaminants in addition to those found in the original process water, this fluid would be routed back to the process stream to be used; e.g., in the injection solution.

4. Ongoing delivery of gypsum slurry to the gypsum deposition area would keep the gypsum damp and eliminate the likelihood of wind-born gypsum. Water for this washing is included in the average 100 gpm used in the proposed process.

5. Control equipment would be installed to monitor process flows. This equipment would include alarm systems to alert operators in case of abnormalities.

6. Process surge tanks would be placed in spill containment berms equipped with sump pumps to lessen the likelihood of an uncontrolled release of process solutions.

7. High quality materials would be used in constructing and maintaining the mining operation to lessen the likelihood of failed equipment and damage to the area.

2.2.5.3 OPERATIONAL PROCEDURES

Numerous operational protection measures would be employed on a routine basis to help prevent impacts, including the following:

1. Periodic site inspections and management audits would be performed by various operational personnel to monitor the effectiveness of the ongoing maintenance programs and environmental safeguards.

2. An ongoing training program would be maintained for operational personnel in both safety and environmental protection.

3. A "suggestion box" would be available to workers throughout the facility so that anyone could submit suggestions on ways to improve the operation, especially with respect to reducing environmental impacts.

4. An equipment inspection and maintenance program would be implemented to minimize emissions from fuel-burning equipment.

2.3 PROJECT ALTERNATIVES

2.3.1 PROCESS PLANT SITING CONSIDERATIONS

The process plant should be as close as possible to the in-place ore deposit. SCE will not allow railroad activity under their high voltage transmission lines; therefore, the processing plant must be located east of the transmission lines. Assuming also that maximum use of existing roads remains a primary concern, thus minimizing impact of building additional access mileage, the plant must be located on or west of Pisgah Crater Road. Additionally, by locating the process plant anywhere east of the proposed site location, visual impacts to the north are increased due to the low topographical relief of the area.

Moving the process site further from the ore body (which cannot be moved) would increase the total length of access roads to both the well field and the gypsum deposition area. The associated pipeline distances would also increase. Longer pipelines have an increased possibility of pipe failure that could result in accidental releases of process fluids to the environment.

The process plant could not be located on top of the lava flow in the area without excessively increasing construction costs and causing potentially significant adverse impacts to the lava flow, a BLM-designated Research Natural Area.

2.3.2 ALTERNATIVE PROCESS PLANT LOCATIONS

The siting constraints discussed above limit possibly suitable alternative locations for the process plant. Three alternative locations have been identified that may satisfy the siting constraints and are evaluated in further detail in this document. These sites are located in the northeastern portion of Section 30, the southwestern portion of Section 19, and the southeastern portion of Section 20. Specific site locations and associated reconfigurations of linear facilities (road, railroad spur, pipelines) are shown in Figure 2.3-1. The acreages of the project alternatives are presented in the following tables.

Alternative 1

Facility	**Acres Disturbed**	**Length of ROW (in feet)** [1]	**Width of ROW (in feet)**	**Acres of ROW**
Well Field	273	N.A.	N.A.	N.A.
Process Plant	10	N.A.	N.A.	N.A.
Gypsum Deposition Area	16	N.A.	N.A.	N.A.
Electrical Transmission Line	0 [2]	7,280	25	4
Water Pipeline	20 [3]	50,596	20	23
Railroad Spur	3 [4]	5824	100	13
Natural Gas Pipeline	0 [5]	3,640	25	2
Access Roads #1	2	728	125	2
#1a [6]	19	6,552	125	19
#2	3	N.A.	N.A.	N.A.
#3	6	N.A.	N.A.	N.A.
TOTAL	352	104,610	20-125	63

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[1] Several of the facilities would not require rights-of-way, either because they would be placed on private land or because they are not the type of facility to which rights-of-way apply. These are designated by "N.A.," (not applicable), in the table above.

[2] The right-of-way for the electrical transmission line would occur within the right-of-way for the access road, therefore, no additional land disturbance would result.

[3] The easternmost portion of the water line would be placed within the right-of-way for the access road, therefore no additional land disturbance would result.

[4] Only 25 feet of the 100 foot wide railroad right-of-way would be disturbed, hence, the disparity between the total right-of-way acreage versus the total disturbed acreage.

[5] The right-of-way for the natural gas pipeline would occur within the right-of-way for the access road, therefore, no additional land disturbance would result.

[6] Access Road #1a extends from the process plant to the easternmost edge of Section 25.

Alternative 2				
Facility	**Acres Disturbed**	**Length of ROW (in feet)[1]**	**Width of ROW (in feet)**	**Acres of ROW**
Well Field	273	N.A.	N.A.	N.A.
Process Plant	10	N.A.	N.A.	N.A.
Gypsum Deposition Area	16	N.A.	N.A.	N.A.
Electrical Transmission Line	0 [2]	7,280	25	4
Water Pipeline	20 [3]	48,412	20	22
Railroad Spur	5	8,008	100	18
Natural Gas Pipeline	0 [4]	5,096	25	3
Access Roads: #1	6	2,184	125	6
#1a [5]	15	5,096	125	15
#2	N.A.	N.A.	N.A.	15
#3	6	N.A.	N.A.	N.A.
TOTAL	354	76,076	20-125	68

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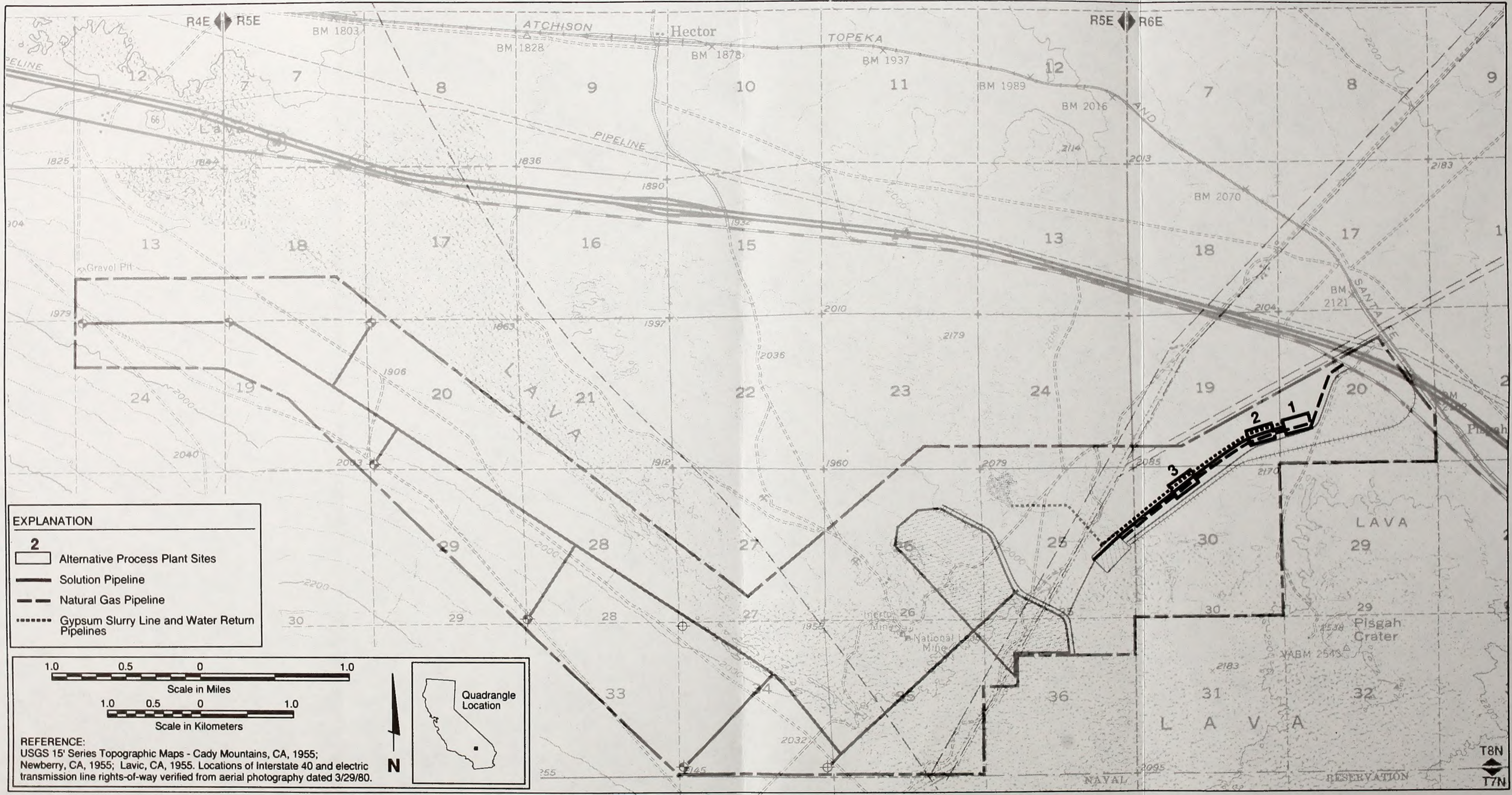
[1] Several of the facilities would not require rights-of-way, either because they would be placed on private land or because they are not the type of facility to which rights-of-way apply. These are designated by "N.A.," (not applicable), in the table above.

[2] The right-of-way for the electrical transmission line would occur within the right-of-way for the access road, therefore, no additional land disturbance would result.

[3] The easternmost portion of the water line would be placed within the right-of-way for the access road, therefore no additional land disturbance would result.

[4] The right-of-way for the natural gas pipeline would occur within the right-of-way for the access road, therefore, no additional land disturbance would result.

[5] Access Road #1a extends from the process plant to the easternmost edge of Section 25.



REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

ALTERNATIVE SITES

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 2.3-1

DAMES & MOORE
21864-001-001

ALTERNATIVE 3				
FACILITY	ACRES DISTURBED	LENGTH OF ROW (IN FEET) [1]	WIDTH OF ROW (IN FEET)	ACRES OF ROW
Well Field	273	N.A.	N.A.	N.A.
Process Plant	10	N.A.	N.A.	N.A.
Gypsum Deposition Area	16	N.A.	N.A.	N.A.
Electrical Transmission Line	0 [2]	7,280	25	4
Water Pipeline	20 [3]	44,408	20	20
Railroad Spur	6[4]	10,920	100	25
Natural Gas Pipeline	0 [5]	9,828	25	6
Access Roads: #1	18	6,552	125	18
#1a [6]	2	728	125	2
#2	3	N.A.	N.A.	N.A.
#3	6	N.A.	N.A.	N.A.
TOTAL	354	79,716	20-125	75

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[1] Several of the facilities would not require rights-of-way, either because they would be placed on private land or because they are not the type of facility to which rights-of-way apply. These are designated by "N.A.," (not applicable), in the table above.

[2] The right-of-way for the electrical transmission line would occur within the right-of-way for the access road, therefore, no additional land disturbance would result.

[3] The easternmost portion of the water line would be placed within the right-of-way for the access road, therefore no additional land disturbance would result

[4] Only 25 feet of the 100 foot wide railroad right-of-way would be disturbed, hence, the disparity between the total right-of-way acreage versus the total disturbed acreage.

[5] The right-of-way for the natural gas pipeline would occur within the right-of-way for the access road, therefore, no additional land disturbance would result.

[6] Access Road #1a extends from the process plant to the easternmost edge of Section 25.

2.4 NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed project would not be implemented. The colemanite deposit would not be mined and boric acid would not be recovered. The land would continue to be managed consistent with management policies of the BLM and the County of San Bernardino.

2.5 IMPACT COMPARISONS FOR PROPOSED ACTION AND PROJECT ALTERNATIVES

The following discussion and table focus on the potential environmental impacts expected from the proposed action and the alternative process plant sites.

The three alternatives to the proposed action vary with respect to the location of the process plant. Several key elements of the project, including available groundwater, the ore body, the gypsum deposition area (by agreement with the USFWS), and existing infrastructure locations, cannot be moved, and therefore limit the possibilities for process plant location. The three evaluated alternative plant sites are located along the proposed access/ancillary facilities corridor between the proposed action site and the main local access road. In general, a decrease in railway/roadway and infrastructure length along this corridor is matched by a corresponding increase in project water lines, solution pipelines and access requirements within the site. For all resource areas except visual quality and cultural resources, the three process plant alternative sites were found to cause a negligible difference in impacts when compared to the proposed action. Adverse cultural resource impacts and visual impacts were expected to increase for all of the three alternatives, and hydrology would remain the single significantly-impacted resource area for the three alternatives as it is for the proposed action. A detailed analysis of the alternatives is presented in Section 4.2.

TABLE 2.5-1

POTENTIAL ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES PROPOSED AND ALTERNATIVE PROCESS PLANT SITES

IMPACTS	MITIGATION MEASURES
GEOLOGY:	
Construction and closure activities would result in areas with a heightened susceptibility to wind or water erosion. Similar for all alternatives.	•Disturbed areas shall be reclaimed.
HYDROLOGY:	
Minor alteration of surface water drainage patterns could result in flooding and erosion during construction and closure. Similar for all alternatives.	•Proper engineering design shall be implemented.
Consumptive groundwater use would be approximately 161 acre-feet per year, which would lead to local drawdown of the aquifer and may exceed the estimated safe yield of the aquifer. Similar for all alternatives.	•No substantial mitigation is possible. However, the following measures shall be implemented in order to provide additional assurance that adjacent aquifers are not affected by migration of mining process solutions: ✓ Additional monitoring of piezometric levels within the mining area and vicinity shall be carried out and the hydraulic gradient in the ore zone area would be evaluated. ✓ Following completion of mining activities, and as part of closure, extraction wells shall be pumped to remove formation fluids until low-pH fluids have been removed and fluids of normal pH are produced. ✓ Recycled water shall be used to reduce a total water consumption during operational activities.

IMPACTS	MITIGATION MEASURES
CLIMATE AND AIR QUALITY:	
Emissions of SO_2, NO_x, CO, ROG, and PM_{10} from combustion emissions from use of heavy-duty equipment, and fugitive dust emissions from earth-moving activities and vehicular travel over dirt and gravel roads. Similar for all alternatives.	•Construction shall be curtailed during high winds (i.e., 10m/sec). •Exposed, disturbed surfaces shall be watered and/or revegetated as soon as practical to prevent wind-blown dust. •Vehicular dust generation on access roads shall be minimized by applying water or approved dust pallatives to all unpaved roads. •A speed limit of 15 mph shall be posted and enforced on all unpaved roads. •The contractor shall establish physical barriers to define the construction site and limit unnecessary disturbance beyond the actual construction zone. •Construction equipment shall be maintained as per manufacturer's specifications.
Emissions of NO_x, ROG, CO, SO_2, and PM_{10} from point and mobile sources would increase during operation. Similar for all alternatives.	•The operator shall implement an inspection and maintenance program to reduce fugitive emissions from organic solvent handling equipment (i.e., valves, flanges, and pumps). •The operator shall implement a ridesharing program to reduce commuter vehicle trips. •Optimal combustion conditions shall be maintained on driers and the cogeneration facility in order to reduce emissions of air pollutants. •The baghouse dust collection system, used for PM_{10} removal, shall be inspected, cleaned, and maintained regularly to promote maximum removal efficiency approaching system design levels. •The acid absorption system, shall be inspected, cleaned, and maintained regularly to promote maximum removal efficiency approaching system design levels. •Vehicular dust generation on access roads shall be minimized by applying water or approved dust pallatives on unpaved roads. •After the project is under operation, FCMC shall evaluate the feasibility of paving the main access road.
NOISE:	
No significant adverse impacts are expected. Similar for all alternatives.	None required.

IMPACTS	MITIGATION MEASURES
BIOLOGICAL RESOURCES:	
PLANTS: Construction and closure impacts on botanical resources would include removal of vegetation at facility sites and access roads; establishment of undesirable weedy vegetation; the compaction of soil which could lead to difficulty in reestablishing native vegetation; and the loss of individuals or small populations of sensitive plant species. Operation impacts would include the potential for further degradation of plant habitat. Similar for all alternatives.	•At the end of the project, disturbed areas, including new access reads, shall be recontoured and reseeded with appropriate mixture of native plant species according to BLM specifications.
WILDLIFE: Construction and closure impacts on general wildlife and sensitive species would include loss or displacement of individual animals and sensitive desert tortoises; loss or degradation of habitat and habitat features; as well as the fragmentation of desert tortoise habitat. Operation impacts would include the potential for further degradation of wildlife habitat. The beneficial impact of increasing nighttime prey for the California leaf-nosed bat would also result during operation. Similar for all alternatives.	•The mine operator shall designate a field contact representative (FCR), with authority to halt all mining activities that are in violation of any stipulations, who shall be responsible for overseeing compliance with protective stipulations for the desert tortoise and coordination of compliance with the BLM and USFWS. •At least 30 days prior to construction activities, a survey shall be conducted by qualified biologists to identify sensitive species and record their location. •When maintenance activities occur outside of areas enclosed by desert tortoise-proof fences, work areas shall be surveyed by the authorized biologist prior to the onset of maintenance to determine whether desert tortoises are present. •A worker education program shall be implemented. •No on-site collection or killing of sensitive plant or wildlife species shall be permitted. •Travel shall be limited to approved roads and off-road use shall be prohibited. If desert tortoise-proof fencing is not constructed along the water pipeline, all project-associated vehicles shall maintain a speed limit of 15 mph on this access road. •When outside of areas enclosed by desert tortoise-proof fences, workers shall inspect underneath any parked vehicles immediately prior to moving the vehicles. •Land disturbance during construction shall be restricted to the smallest area required. •A trash abatement program shall be implemented.

IMPACTS	MITIGATION MEASURES
WILDLIFE (con't.)	•Structures that may function as common raven nesting or perching sites shall not be authorized except as specifically stated by the BLM. •Contractor shall be responsible for post-construction clean-up. Following completion of construction, barriers shall be erected to limit traffic to the main access roads. •Hazardous material spills, including spills of oils, coolants, grease, diesel fuel, and gasoline shall be cleaned up immediately and the hazardous materials removed. Maintenance yards and containment areas shall be cleaned at the end of the project. •A final inspection shall be conducted to evaluate additional impact to desert tortoise habitat and no later than 90 days after completion of construction activities, the FCR and authorized biologist shall prepare a report for the BLM and CDFG. •Acid solution resulting from spill areas shall be promptly neutralized and cleaned-up to prevent animals and birds from ingesting the solution. •After site rehabilitation, all desert tortoise-proof fence shall be removed. •The sides of the gypsum deposition area shall be gently sloped so as to reduce the possibility of entrapment or drowning. •If feasible, construction shall take place during periods when tortoises are least active. •An authorized biologist shall be required on-site during pre-construction and construction activities which could harm desert tortoises. •An authorized biologist shall maintain a record of all desert tortoises encountered during mining activities. •Construction sites shall be surveyed 30 days, 72 hours, and again immediately prior to the commencement of construction activities. •In general, desert tortoises shall be moved the minimum distance possible to ensure their safety. •Only qualified biologists shall handle tortoises, and accepted protocol for marking and displacement of tortoises shall be followed.

IMPACTS	MITIGATION MEASURES
WILDLIFE (con't.)	•An authorized biologist shall instruct appropriate mine employees in the proper method of handling desert tortoises in the event of emergencies involving animals during routine operation of the facility; or FCMC shall retain a local, BLM/USFWS-authorized biologist available on short notice. •All project facilities should be enclosed within desert tortoise-proof fences. •After fence installation, an authorized biologist shall conduct a thorough survey for desert tortoises within all enclosed areas. •Desert tortoises moved from within a fenced site shall be marked for future identification. •A protocol specific to handling of hatchlings shall be developed. •Reduction of habitat fragmentation caused by the above-ground pipeline shall be accomplished by periodic elevation or burial of the pipeline, or construction of ramps over the pipeline. •Reduction of habitat fragmentation shall be reduced through the installation of culverts or underpasses under the access roads and the railroad at all washes and at 0.5 mile intervals. •Pets, especially dogs, shall not be permitted on site. •1,480 acres of off-site desert tortoise habitat lands shall be transferred to the BLM by the proponent to compensate for unmitigated desert tortoise impacts.
LAND USE/RECREATION:	
An inconsistency between the proposed process plant building height and the planning policies of the County Rural Conservation Land Use District and The Airport Hazard Overlay Zone would result during operation. Variances shall be filed and are expected to be approved. Similar for all alternatives. Conflicts between the land use of the proposed action and the proposed Pisgah Crater Area of Critical Environmental Concern could result from operation. Similar for all alternatives.	• No mitigation required. •An attempt to notify individuals or institutions conducting research in the Research Natural Area shall be made. Reduction of habitat fragmentation caused by the above-ground pipeline shall be accomplished by periodic elevation or burial of the pipeline, or construction of ramps over the pipeline.

IMPACTS	MITIGATION MEASURES
VISUAL RESOURCES:	
No significant adverse impacts are expected. Impacts for all alternative sites would be greater than the proposed site.	•None required. Although no significant adverse impacts are expected, adverse visual impacts shall be mitigated according to the overall goals of the BLM Visual Resource Management Program. Measures include: ✓ Landform screening shall be incorporated wherever feasible; ✓ Surface disturbances shall be minimized, especially those which highlight lava/soil contrasts; ✓ Structure colors shall blend with predominant background colors; ✓ Night-lighting shall be shielded to minimize off-site glare and visibility; ✓ Implementation of Reclamation Plan measures for vegetation and soil disturbances; and ✓ Graded surfaces shall gradually blend the color, texture, and contour of adjacent sand and lava surfaces.
TRANSPORTATION:	
No significant adverse impacts are expected. Similar for all alternatives.	None required.
CULTURAL RESOURCES:	
Impacts on cultural resources, including destruction or displacement of cultural deposits and loss of scientific information could occur during construction. Alternative sites would impact more resources than the proposed site in all cases. Proposed project and alternatives would have no effect on potential eligibility of Route 66 (National Trails Highway) or Atchison Topeka and Santa Fe Railroad as historic transportation routes.	•If feasible, cultural resources shall be avoided. • If previously unidentified cultural resources are encountered, construction activities shall be halted until a qualified archaeologist is consulted regarding the significance of the finds. The BLM shall be notified and concerned Native Americans shall be involved, where appropriate. •Worker and visitor education with respect to not disturbing cultural resources shall be implemented.
PALEONTOLOGICAL RESOURCES:	
Fossils could be subject to destruction and loss during construction. Similar for all alternatives.	•A paleontologist shall spot check construction activities in areas where paleontological resources are most likely to be found. •Worker education with respect to the potential for uncovering fossil remains and the legal protection such fossils are afforded shall be implemented.

IMPACTS	MITIGATION MEASURES
SOCIOECONOMICS:	
No significant adverse impacts are expected. Similar for all alternatives.	None required.

Under the No Action Alternative, the adverse impacts identified with the proposed action would not occur. In addition, the loss of the relatively small beneficial economic and employment impacts associated with the No Action Alternative is not expected to make a substantial difference in the overall regional economy. If the project were not developed, however, the potential for some reduction in the dependence of American manufacturers on foreign imports of boric acid would not exist, and the potential to increase foreign export of boric acid would not exist. Other benefits which would not be realized include the potential reduction of consumer costs for certain industrial products and the opportunity to establish a track record of the in-situ mining process for further use of the technique. Based on these considerations, the No Action Alternative would be less economically desirable than the proposed action.

2.5.1 AGENCY PREFERRED AND ENVIRONMENTALLY SUPERIOR ALTERNATIVE

Under the National Environmental Policy Act (NEPA), as directed by the Council on Environmental Quality, 40 CFR 1502.14(e), federal agencies are required to identify the agencies' preferred alternative. The BLM has evaluated the proposed action taking into account BLM policies, land use plans (particularly the California Desert Conservation Area Plan; CDCA), and the results of the environmental analysis in this EIS/EIR. The proposed action is consistent with BLM policies regarding mining and with the CDCA. The environmental analysis has not identified alternatives with less impacts than the proposed action. Therefore, the proposed action is the BLM's preferred alternative.

Section 15126(d)(2) of the California Environmental Quality Act (CEQA) requires that the lead agency (state or local) for preparation of an EIR identify an environmentally superior alternative. If the No Action alternative is the environmentally superior alternative, then the identification is to be made from the other alternatives considered. In the case of the FCMC proposed action, the No Action alternative would be environmentally superior. Based on the results of the analyses for other alternatives summarized above, the proposed action is considered environmentally superior to the other alternatives.

2.6 ALTERNATIVES ELIMINATED FROM DETAILED CONSIDERATION

2.6.1 MINING METHODS

Two alternative methods for mining this ore body were considered and eliminated from detailed consideration. These methods are discussed below.

2.6.1.1 UNDERGROUND METHOD

The underground method would require at least one shaft down to an average depth of approximately 1,400 feet to the level of the ore. From this ore penetration point, cross cut tunneling would then take place to recover the colemanite ore. The ore would then be lifted to the surface for further processing and marketing.

However, detailed mine planning and analysis of the ground characteristics at ore level indicated that underground tunnel, drift driving mining methods would be very difficult, dangerous, and expensive due to the instability of the overburden. This overburden would require substantial support work and equipment to be maintained and to keep the mine open and in safe condition.

In addition, significant environmental impacts would occur, since large amounts of underground material would be moved to the shaft areas and working rooms, and the clay between ore horizons would be removed and placed on the surface.

Because of the costs, safety concerns, depth and grade of the ore, and the potentially adverse environmental impacts, the underground mining alternative is not considered feasible.

2.6.1.2 OPEN PIT METHOD

The open pit mining method was considered. Since the depth of the ore is an average of 1,400 feet, this method would result in a large, deep pit. The depth of ore at 1,400 feet would lead to a stripping ratio of at least 11.9 to 1. The relatively low grade of the ore compared with the high stripping ratio renders this method economically infeasible. In addition, the overburden would need to be removed and placed in surrounding areas, which would lead to potentially significant adverse environmental effects on sensitive biological resources. Therefore, this method is not considered environmentally preferable to the proposed action.

2.6.2 ALTERNATIVE TECHNOLOGIES

Several alternative technologies were evaluated for use in the proposed action. Those eliminated from detailed consideration included the following: mechanical evaporation eliminated because of the high energy consumption and concomitant cost involved; solution cooling, eliminated as a "stand alone" process step because of its inefficiency; and solvent extraction, also eliminated as a "stand alone" process step because of inefficiency. However, as described in detail in Section

2.2, the proposed action involves a joint process of solution cooling and solvent extraction. The four alternatives are briefly described below and the evaluation of their feasibility is also presented.

2.6.2.1 SOLAR EVAPORATION ALTERNATIVE

The first step in the FCMC in-situ recovery method for boric acid production is the initial concentration procedure, and solar evaporation is one method for concentrating boric acid. As the solution is recovered from the well, the boric acid concentration is approximately five percent. The solar evaporation alternative would involve placing solution from the well field in plastic-lined ponds. The excess water would be evaporated by solar energy, and as the concentration of the dissolved solids in the solution increases, the boric acid would precipitate. The precipitate would then be harvested and sent to the process plant for purification/crystallization. The crude boric acid must be enhanced to a concentration of at least 30 percent for the process to be economically feasible. This method would work quite well in very warm desert areas, such as within the vicinity of the proposed action.

All of the pilot work was done using solar evaporation ponds. However, after more detailed study of both environmental impacts and economic viability, certain shortcomings were apparent with this method. One problem with the solar evaporation process is that as evaporation takes place, and the solution becomes richer in boric acid and calcium chloride, chemical activity decreases markedly. The more concentrated the solution becomes, the slower the evaporation process progresses. To compensate for this problem, larger ponds would be needed than were originally estimated. In the final analysis it was apparent that at least 280 acres of wetted surface (at least 432 acres of disturbed land incorporating pond berms and construction areas) would be required for the designed production rate.

Another significant impact would be the large requirement of process water to replace that which evaporated from the solar ponds. The consumptive use was estimated to be approximately 930 gallons per minute, 24 hours per day.

With larger ponds than originally estimated, the capital cost of the ponds would escalate. Furthermore, with the significant increase in pond size, the method of harvesting the crystals would also not be technically practical. The larger ponds would result in a significant increase in the amount of in-process boric acid inventory.

2.6.2.2 MECHANICAL EVAPORATION

Instead of using solar energy to evaporate the excess water from the recovered well field solution, mechanical means would be used to heat the solution, which is maintained in a vacuum (thereby lowering the effective boiling point).

Detailed investigation of the mechanical evaporation alternative indicated that energy consumption would be quite high if used in this project. With the additional energy consumption and associated cost (especially during the winter months) and the amount of consumptive water use necessary, this method was considered the least feasible of the alterative methods.

2.6.2.3 SOLUTION COOLING

Cooling the well field recovered solution reduces the solubility of boric acid in the fluid. This decreased solubility results in some of the boric acid precipitating.

The inefficiency of the cooling process prevented this method from being considered a feasible "stand alone" alternative, since only 35 to 40 percent of the boric acid could be recovered by this method without significant amounts of energy being consumed to cool the solution further. This is especially true in the summer.

However, it was found that this method could be used in conjunction with the solvent extraction method to reduce the process plant size. The proposed processing method uses a simple cooling tower to cool the well field recovery solution to approximately 60 degrees fahrenheit. This results in obtaining approximately 35 percent of the boric acid in the first crop of crude boric acid crystals.

2.6.2.4 SOLVENT EXTRACTION

The solvent extraction process involves mixing boric acid aqueous solution with an organic isooctanol dissolved in kerosene. The isooctanol binds chemically to the boron, thereby becoming "loaded." After the isooctanol is fully loaded, it is stripped using a five-percent solution of sulfuric acid. The acid strips the boron from the isooctanol and forms boric acid in a more concentrated solution. The isooctanol is then routed back to the loading section of the process plant. Many metal species (e.g., uranium, vanadium, and copper) are recovered in commercial quantities with solvent extraction. In fact, one of the U.S. boric acid producers currently uses this method as part of their processing.

Employing both alternatives 3 and 4, in other words first cooling the solution and then using solvent extraction, was adopted as the processing method of choice (i.e., the proposed action) after extensive testing, since it leads to necessary process efficiency, reduces energy consumption, and minimizes surface disturbance and water consumption.

2.6.3 ALTERNATIVE LOCATIONS

2.6.3.1 COLEMANITE DEPOSIT LOCATIONS

Prior to acquisition of the proposed site, FCMC investigated other locations for colemanite deposits in California. Listed below are the known California deposits:

	Million Short Tons	
Deposit	**Ore Body**	**Borate**
Proposed site	147.4	9.39
Billie Mine	17.0	3.95
White Monster-Sigma	13.0	2.4
Inyo	2.0	0.45
Rho A & B	82.0	8.14

The proposed site was selected because it represented the largest deposit, was available for purchase, and was the lowest cost.

2.6.3.2 OFF-SITE GYPSUM WASHING

The concept of washing the acid-laden gypsum (that results from processing) at an off-site location was assessed. This alternative would require construction and operation of a facility at another location to (1) wash the gypsum to recover the acid for reuse at the project site; (2) neutralize any remaining acid in the gypsum with lime; and (3) dry the gypsum for sale or storage depending on market conditions. Recovered acid would be trucked back to the project site. This alternative would eliminate the need for the gypsum deposition area at the project site.

Elimination of the gypsum deposition area at the project site would reduce impacts on cultural resources and biological resources. However, new impacts would occur at the location selected for gypsum washing. Those impacts would include loss of biological habitat and possible effects on cultural resources. Furthermore, transportation of acid-laden gypsum to the washing facility and recovered acid back to the project site would increase traffic impacts, air pollutant emissions, accident risks for a hazardous material (acid), and energy consumption. Locating part of the process operation (gypsum washing) off-site would result in more impacts than use of the project site. For this reason, off-site gypsum washing was eliminated from detailed analysis.

2.6.4 ALTERNATIVE TRANSPORTATION

The proposed project includes use of rail and truck transportation. An alternative would be to eliminate rail transport. A rail car can accommodate 100 tons of material; a truck's capacity is 20 tons. Current estimates are that about 1,773 rail cars per year (approximately 5 per day) would be needed for the proposed project. If these were eliminated, there would be a need for about 8,865 trucks (approximately 25 per day) to provide substitute capacity. This level of truck transportation would increase traffic impacts, air pollutant emissions, and energy consumption. The level of air quality and energy consumption impacts is expected to be greater without the use of rail. Therefore, elimination of rail transport was dropped from further analysis.

Section 3.0

Environmental Setting

3.0 ENVIRONMENTAL SETTING

3.1 GEOLOGY

This section contains descriptions of the regional and immediate project area topography and geology, including seismicity and geologic and seismic hazards. The following discussion is based primarily on information contained on United States Geological Survey (USGS) topographic and geologic maps and in other available geologic literature; site-specific reports prepared for FCMC and other FCMC proprietary documents; and observations made during site field reconnaissance.

For the purposes of the following discussion, the project area encompasses the area depicted on Figure 1.2-2.

3.1.1 TOPOGRAPHY

The project area is located within the Mojave Desert physiographic province, approximately 35 miles east of Barstow, California. The project area is situated in a southeastward projection of the Mojave Valley, which is bounded on the north and northeast by the Cady Mountains, on the southeast by the Bullion Mountains, on the southwest by the Lava Bed Mountains, and on the northwest by the main part of the Mojave Valley. The surrounding upland areas trend roughly northwest to west-northwest.

The project area is located in the south-central portion of the southeastward projection of the Mojave Valley, approximately two miles south of the valley axis. Topographic relief within the project area is relatively low, with low hills separated by washes in the northern and eastern portions of the project area and basalt flows covering the ground surface in the central and southern portions of the project area. The western portion of the project area slopes gently toward the northeast where the south margin of a lava flow approximately coincides with the project area boundary. The eastern portion of the project area slopes gently to the west, while the lava flow surface in the central portion of the project area is almost level with a very small topographic gradient to the northwest. The north-central portion of the project area comprises the southern end of an area of north-south trending low hills and slopes to the south. Elevations within the project area range from approximately 1,880 feet Mean Sea Level (MSL) at the northwestern end of the project area to a high of 2,145 feet MSL at the southwest corner of the project area.

There are three principal drainages within the project area, all of which empty into the westward-draining valley axis drainage approximately three miles north of the project area. One drainage occurs in the central portion of the project area where runoff from the lava flow drains generally northward to northwestward into a topographically low wash that runs along the north margin of the basalt flow. The low hills in the north-central part of the project area also drain south to southwestward into this wash. The second drainage is in the western portion of the project area where drainage from the alluvial fan south of the project area drains into a wash which runs along the southern margin of the lava flow. The third drainage is located in the eastern portion of the site where drainage from the lava flow from the south and east drains into a wash which runs in a northerly direction towards the valley axis.

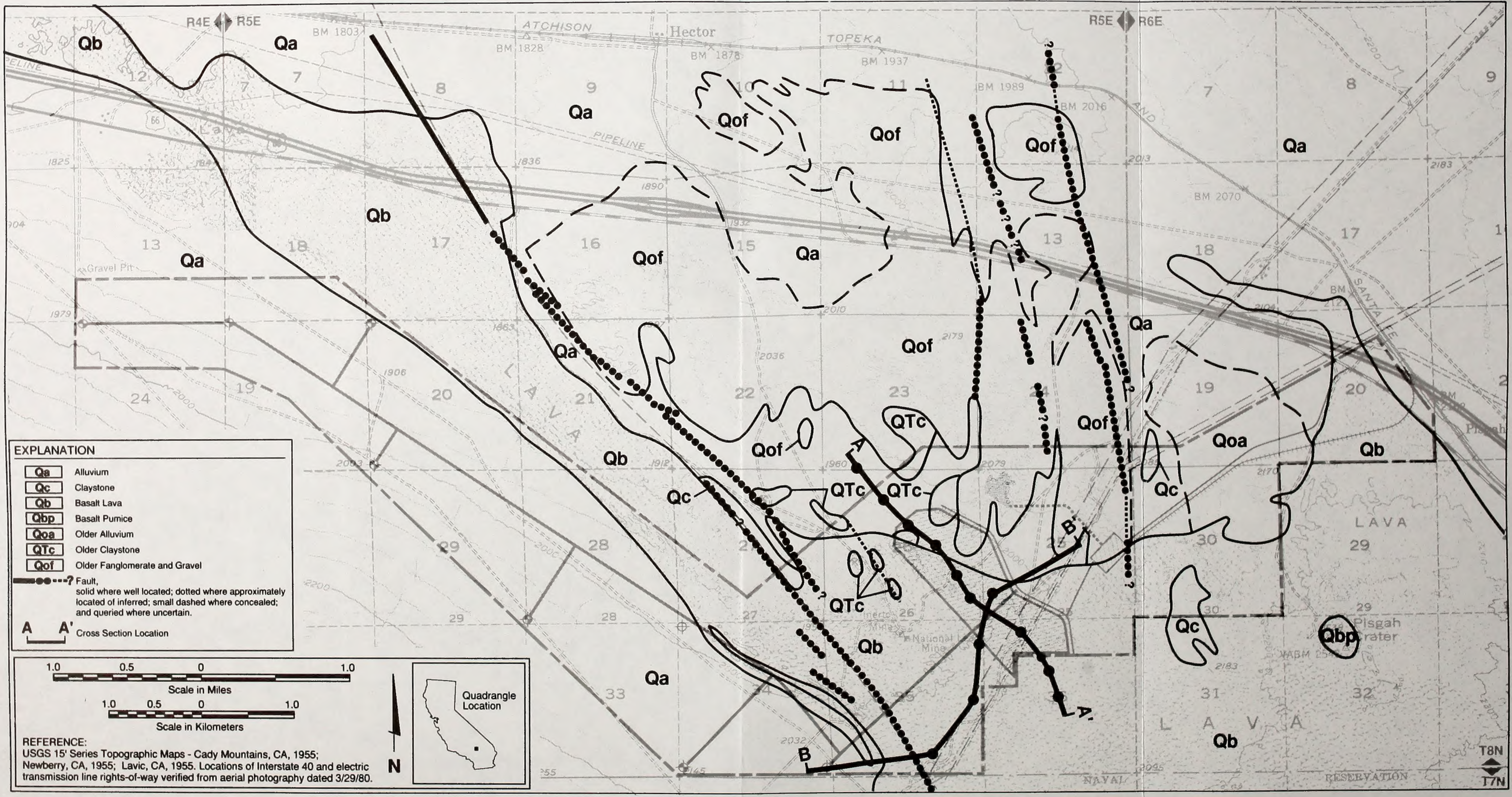
3.1.2 GEOLOGY

3.1.2.1 REGIONAL OVERVIEW

Regional geologic information in this report was compiled, unless otherwise indicated, from Dibblee (1980a, 1980b). The project area is located in the Barstow Trough of the central Mojave. The Mojave comprises a structural entity commonly referred to as the Mojave block, and is bounded on the southwest by the San Andreas fault zone and the Transverse Ranges, on the north by the Garlock fault zone, and on the east by the Death Valley and Granite Mountain faults. The central Mojave region is made up of a number of relatively low mountain ranges separated by intervening basins which are floored primarily by alluvium. The central Mojave area is cut by numerous faults of various orientations but which predominantly trend to the northwest.

3.1.2.2 REGIONAL STRATIGRAPHIC SETTING

The oldest rocks exposed in the central Mojave area are Precambrian in age, and consist primarily of gneissic metamorphic and granitic igneous rocks. The Precambrian rocks are severely deformed and are presumed to underlie younger rock units throughout the central Mojave. Paleozoic and younger sedimentary and volcanic rocks were subsequently deposited above the Precambrian units. During the Mesozoic, older crustal rocks were intruded by predominantly granitic igneous plutons which underlie much of the central Mojave area. Subsequent uplift and erosion have removed much of the rock units overlying the plutonic rocks, leaving isolated granitic remnants exposed in the area. The batholithic and older rocks were subsequently uplifted, eroded, and overlain by later Cenozoic and recent alluvial sediments. The surface geology of the region is presented on Figure 3.1-1.



REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

SURFACE GEOLOGY OF THE PROJECT AREA AND VICINITY

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FIGURE 3.1-1

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A dominant feature of the region is the Barstow Trough, which is a structural depression extending northwesterly from Barstow toward Randsburg and east-southeasterly toward Bristol. The Barstow Trough is characterized by thick successions of Cenozoic sediments, including borate-bearing lacustrine deposits, with abundant volcanism along the trough flanks (Gardner, 1980). The northwest-southeast trending trough initially formed during Oligocene through Miocene times. As the basin was filled with sediments and the adjacent highland areas were reduced by erosion, the areas receiving sediments expanded, and playa lakes, characterized by fine-grained clastic and evaporitic chemical deposition, formed in the low areas at the center of the basins. The Barstow Formation, which is found at the surface in the Mud Hills area north of Barstow, comprises the bulk of the Miocene (roughly 13 to 19 million years old) sediments in that area, where its measured thickness is about 1,000 feet (Woodburne, et al., 1990). The Barstow Formation in the Mud Hills area is made up of conglomeratic basal and marginal units, interfingering with marginal and lacustrine sands, muds, and limestones (algal in some cases). Interbedded volcanic ash units, often water-laid and/or zeolitized, occur throughout the unit. Depositional relationships indicate that at least local tectonic activity continued through at least the end of Barstow Formation deposition.

Volcanism periodically accompanied faulting in the region, and was generally more extensive at the beginning of the Cenozoic. Aerially, volcanism was more intense in the Barstow Trough area, where it accompanied development of the structural basin. Volcanics are frequently found intercalated with sediments in the Barstow Trough area (Subsurface Surveys, Inc., 1990).

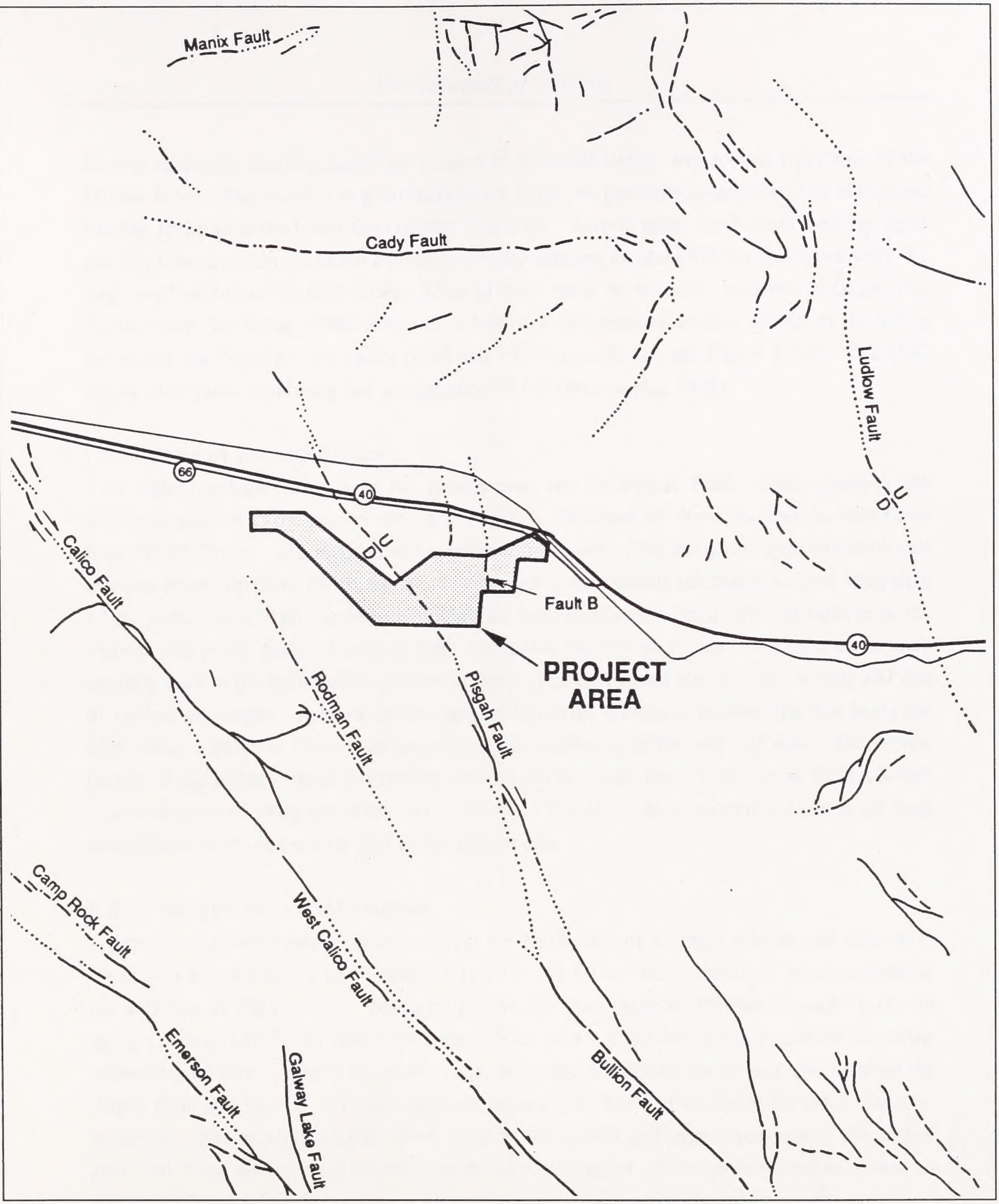
Subsequent tectonic disruption of the area during Pleistocene times resulted in elevation of the present topographically high areas and resulted in filling in of former basin areas with coarser-grained clastic sediments. Accumulation of alluvium has continued in low areas to the present. Cenozoic sediments in the central Mojave area are relatively undeformed, although there is local deformation in the vicinity of the northwest-trending faults.

3.1.2.3 REGIONAL SEISMOTECTONIC SETTING

The project area is located in the south-central portion of the wedge-shaped Mojave block, a structural block bounded by the San Andreas fault zone to the southwest and the Garlock fault zone to the northwest. The eastern tectonic boundary of the Mojave block is vague and poorly defined; however, it is generally represented by an alignment of valleys extending southeastward from Death Valley. Along this alignment, the Death Valley fault zone, evident north of the Garlock fault zone, may extend as a concealed fault southeastward an unknown distance (Dibblee, 1980).

Recent and historical seismicity and the presence of numerous active and potentially active northwest-trending right-lateral, strike-slip faults provides evidence that the Mojave block is tectonically active. The primary driving force for this activity is believed to be associated with transform motion between two major crustal plates, the Pacific and North American plates. The plate motion is thought to be accommodated across a broad zone of California, both east and west of the northwest-trending, right-lateral, strike-slip San Andreas fault system which represents the principal surface manifestation of the zone of plate interaction and is the dominant seismotectonic element of California. Major faults within the Mojave block generally parallel the San Andreas. The northeast to east-west trending, generally left-lateral Garlock fault zone is considered active despite the apparent lack of historic seismic activity clearly attributable to this fault.

Major northwest-trending fault zones of the Mojave block include the Helendale, Lockhart-Lenwood, Camprock-Emerson-Homestead Valley-Johnson Valley, Blackwater-Calico-West Calico-Hidalgo, Pisgah-Bullion, and Ludlow Faults. The faults nearest the project area are shown on Figure 3.1-2. Although the dominant displacement on these sub-vertical fault zones appears to be right-slip, some faults, such as the Pisgah, have significant vertical displacements (Dibblee, 1980a). A regional gravity survey was performed by Subsurface Surveys, Inc. (1990) for the Mojave Water Agency in the west and central Mojave area, ending just west of the project area. The results of that survey indicated that, to a rough approximation, the gravity contours may be viewed qualitatively as structural contours on the bedrock in the area. Evidence for normal, reverse, and strike slip faulting was found, although upthrown and downthrown relationships across strike slip faults were commonly observed to change along the fault trends. Offsets of up to 3 to 4 miles (on the Harper Lake-Waterman Fault) were observed, although offsets of roughly 2 to 2.5 miles, as inferred for the Calico-Newberry Fault, were typical. The majority of these faults, evaluated by the California Department of Conservation Division of Mines and Geology (CDMG) under the Alquist-Priolo Special Studies Zones Act as part of the Mojave Desert study region (except for the Ludlow Fault which was outside the study area), are considered to be Holocene-active (Hart et al., 1987). The 1992 Landers earthquake indicates that these faults are capable of generating large earthquakes.



EXPLANATION

——— — — — ·····? Fault; solid where well located; dashed where approximately located or inferred; dotted where concealed; and queried where uncertain.

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FAULTS IN THE PROJECT REGION

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FIGURE 3.1-2

Several east-west trending faults are present in the northeastern and southern portions of the Mojave block. These active or potentially active faults are generally considered to be high-angle left-slip faults associated with the Garlock fault zone. Several small north-south trending faults are also located within the Mojave block, generally adjacent to, and probably associated with, the large northwest-trending fault zones. Most of these faults do not show evidence of Quaternary displacement (Bortugno, 1986); however, a few have demonstrated historic seismicity, including the Manix and Galway Lake Faults (1947 and 1975, respectively, see Figure 3.1-2). The 1947 Manix earthquake reportedly had a magnitude of 6.2 (Wesnousky, 1986).

3.1.2.4 PROJECT AREA OVERVIEW

Two major geologic features in the project area are the Pisgah Fault, which transects the southwest portion of the project area, trending in a northwesterly direction, and the lava flows from Pisgah Crater. The Pisgah Fault is believed to be one of the many throughgoing northwest trending strike slip faults which are found in the region and exhibits substantial vertical separation in the project area, with the eastern side of the fault upthrown at least 700 feet relative to the western side of the fault. A second fault, designated Fault B on Figure 3.1-2, is a north-south trending fault in the northeastern portion of the project area which also exhibits at least 700 feet of vertical separation. A block of fine-grained lacustrine sediments between the two faults has been raised relative to the coarser-grained alluvial sediments to the east and west. The central portion of the project area is covered by Recent olivine basalt flows from Pisgah Crater, which is located approximately two miles east of the site. The basalt flows roughly parallel to the fault immediately north of the west part of the project area.

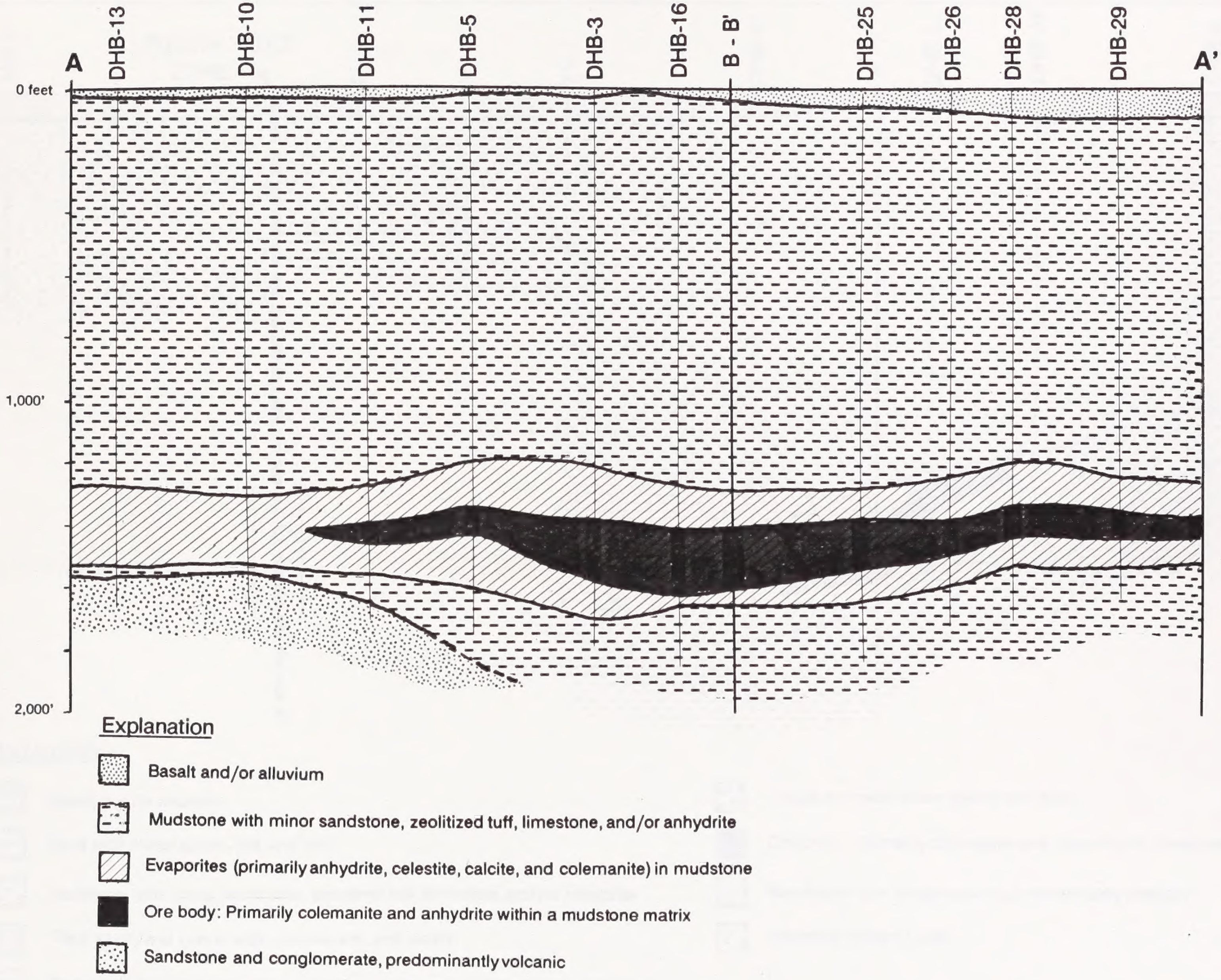
3.1.2.5 PROJECT AREA STRATIGRAPHY

A geologic map and cross sections depicting the distribution of geologic units in and adjacent to the project area are shown on Figures 3.1-1, 3.1-3 and 3.1-4. The locations of the cross sections are indicated on Figure 3.1-1. Strata ranging in age from probable Pliocene through Recent in age are exposed at the surface within the project area. Exposures of fine grained lacustrine sediments and tuffs, possibly Pliocene in age, are found throughout the project area between the Pisgah Fault and Fault B. Younger alluvium occurs in washes and overlying the older lacustrine sediments. Recent olivine basalt flows occur in the central and eastern portions of the project area, and along the northern boundary of the western portion of the project area, as shown on Figure 3.1-1.

The project area east of the Pisgah Fault and west of Fault B lies within an area of thick fine-grained, predominantly lacustrine mudstones which appear to have been uplifted a minimum of 700 feet along both faults, forming an uplifted block of lacustrine sediments that appear to be floored by an andesitic lava flow. A test boring drilled approximately one mile east of the Pisgah Fault (USGS -3 on Figure 3.1-5), in the central ore body area, encountered claystone with lesser amounts of tuff and "calcite rock," and occasional sandstone, to a depth of 1,335 feet where anhydritic rock and colemanite, interbedded with claystone, occurred to the bottom of the boring at 1,660 feet below ground surface (bgs) (Madsen, 1970). This is consistent with data from subsequent exploratory borings drilled in the ore body area, many of which encountered volcanic sands below the lower mudstone layers, and two of which also encountered andesitic volcanic rock at depths of 1,443 and 1,659 feet bgs. Boring logs have consistently demonstrated the presence of a clay layer beneath the evaporite/mudstone body that surrounds and encloses the ore body. The lower clay layer appears to be underlain by volcanic sand and andesitic volcanic rock. Exploratory drilling in the project area indicates that the ore body lies between approximately 1,000 and 1,800 feet bgs.

The ore body consists of variable amounts of calcium borate (colemanite) within a mudstone matrix. X-ray diffraction analysis of the ore body mineralogy indicated the presence of the evaporite minerals anhydrite, colemanite, celestite, and calcite. The mineralogy of the detrital sediments included quartz, illite, feldspars, and clinoptilolite, a zeolite mineral (Rooke, 1982).

Based on exploratory drilling logs provided by FCMC, the ore body is elongate in shape and trends northwesterly. The eastern margin of the ore body appears to be roughly linear, paralleling the Pisgah Fault which lies approximately one mile to the west. Based on the similarity of trend, it appears possible that lacustrine sedimentation in the ore body area was controlled by a structural element paralleling the Pisgah Fault. Although the northwest trending faults in the area are generally considered to be Pleistocene through Recent in age, it is not improbable that the structural element represented by the Pisgah Fault may have existed as early as Miocene times as part of the structure of the Barstow Trough. Although the limits of the enclosing evaporite/mudstone body have not been fully established by drilling and sampling (Figures 3.1-3 and 3.1-4), it is probable that they do not extend far beyond the margins of the ore body. Significant evaporite content was not found in the easternmost exploration boring, and a boring drilled along the ore body trend northwest of the project area (USGS 2, shown on Figure 3.1-5) encountered


A
DHB-13
DHB-10
DHB-11
DHB-5
DHB-3
DHB-16
B - B'
DHB-25
DHB-26
DHB-28
DHB-29
A'
0 feet
1,000'
2,000'
Explanation
Basalt and/or alluvium
Mudstone with minor sandstone, zeolitized tuff, limestone, and/or anhydrite
Evaporites (primarily anhydrite, celestite, calcite, and colemanite) in mudstone
Ore body: Primarily colemanite and anhydrite within a mudstone matrix
Sandstone and conglomerate, predominantly volcanic

CROSS SECTION A-A'

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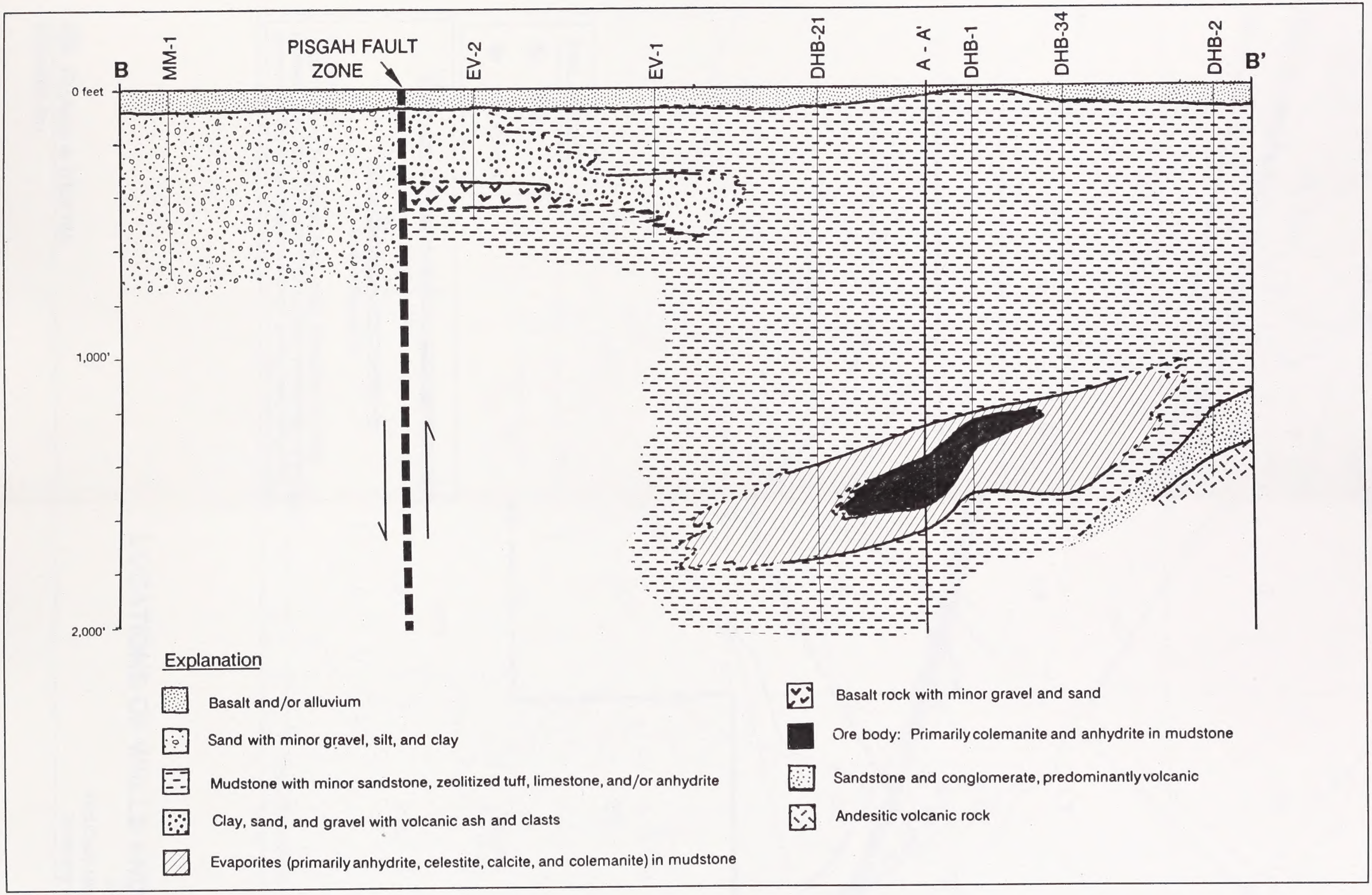
FIGURE 3.1-3


B
MM-1
PISGAH FAULT ZONE
EV-2
EV-1
DHB-21
A - A'
DHB-1
DHB-34
DHB-2
B'
0 feet
1,000'
2,000'
Explanation
Basalt and/or alluvium
Sand with minor gravel, silt, and clay
Mudstone with minor sandstone, zeolitized tuff, limestone, and/or anhydrite
Clay, sand, and gravel with volcanic ash and clasts
Evaporites (primarily anhydrite, celestite, calcite, and colemanite) in mudstone
Basalt rock with minor gravel and sand
Ore body: Primarily colemanite and anhydrite in mudstone
Sandstone and conglomerate, predominantly volcanic
Andesitic volcanic rock

CROSS SECTION B-B'

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FIGURE 3.1-4

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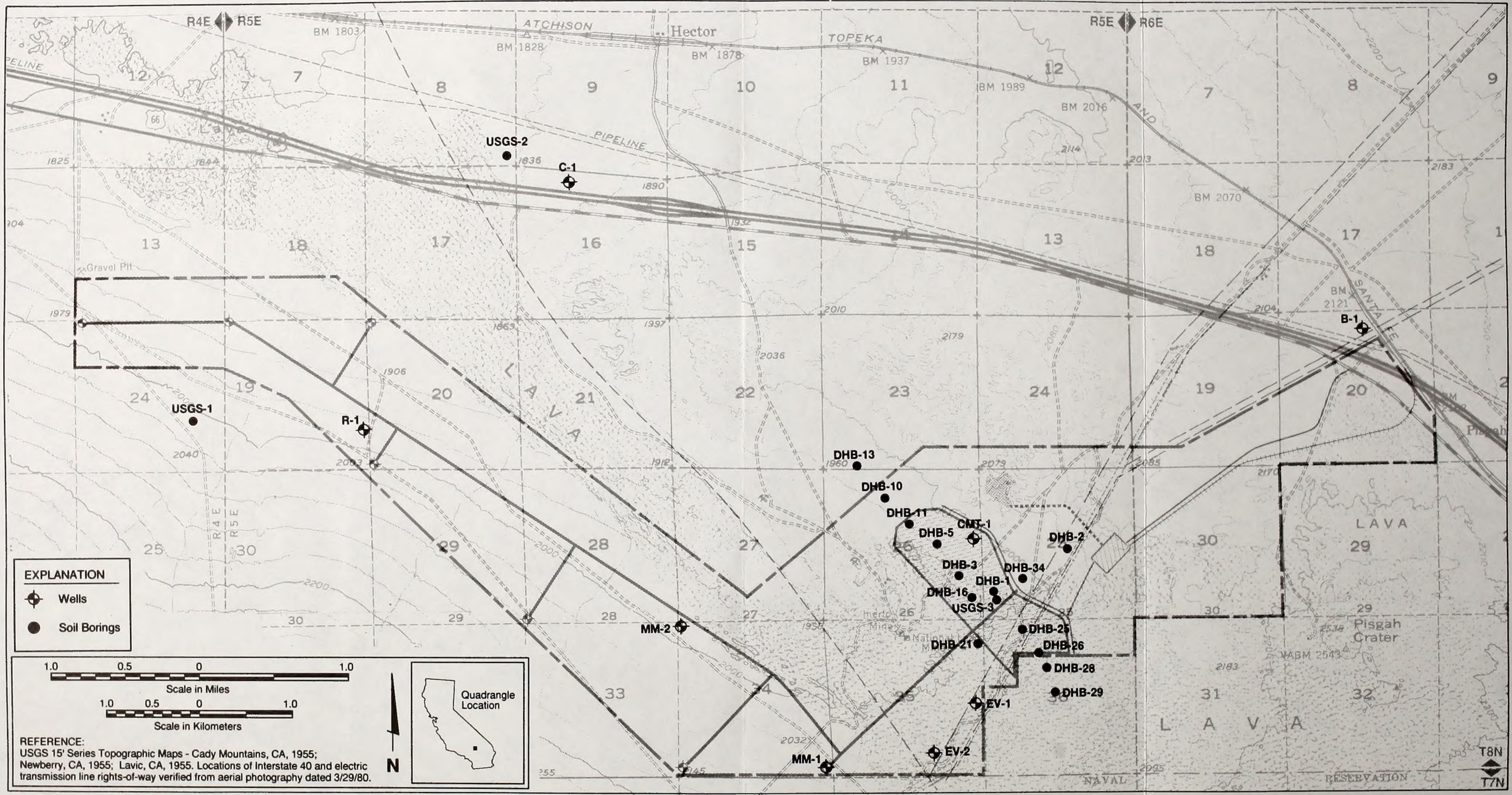

REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

LOCATIONS OF WELLS AND BORINGS

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FIGURE 3.1-5

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only clastic sediments (predominantly mudstone coarsening downward into gravel) to a depth of 900 feet (Madsen, 1970). In addition, an unpublished partial gravity survey map of the local area suggests that the sedimentary basin containing the ore body does not extend more than roughly a mile beyond the north margin of the ore body.

Stratigraphic correlation between boreholes in the project area was provided by the use of a number of marker volcanic ash beds which are believed to be Miocene or Pliocene in age, although the beds have apparently not been radiometrically dated. Based on regional stratigraphy, it seems most likely that the lacustrine sediments correlate with the Miocene Barstow Formation found northwest of the site area, which contains similar fine-grained lacustrine sediments, volcanic ash beds, and limestone and evaporite deposits. Based on detailed analysis of cores from 34 boreholes within the ore body area, it was determined that the ash beds, used as time stratigraphic markers, indicated time-transgressive deposition of the ore body sediments. Consideration of isopach information, which was derived based on time-equivalent intervals, reveals a general southward movement of the basin center and of total evaporite and borate deposition through time, with evaporite deposition being replaced in the north by additional fine-grained clastics (Rooke, 1982). Rooke (1982), based on depositional patterns, felt that the evaporites precipitated out of relatively small ponds, interspersed with fans of incoming silts and clays, with rapid change in the position and amount of incoming clastic deposition. Consideration of present-day depositional patterns in playa lakes suggests that much of the clastic deposition may represent seasonal and storm events that intermittently washed fine-grained clastic materials into areas normally characterized by evaporite deposition. Tectonic controls are the most likely cause of the southward transgressive evaporite depositional trend.

The beds in the ore body area strike from about north 10° west in the south to north 50° west in the north, and dip about 9° to the southwest. The structural trends are consistent through the section and appear to represent post-depositional tilting (Rooke, 1982).

The basin on the west side of the Pisgah Fault, just northwest of the project area, contains at least 2,000 feet of Cenozoic sediments, based on gravity and magnetic survey data supplemented with available well data (Subsurface Surveys, Inc., 1990). A test boring drilled roughly 3 1/2 miles west of the Pisgah Fault just south of the western part of the project area (USGS 1, shown on Figure 3.1-5) encountered sandstone and minor conglomerate to a depth of 1,500 feet (Madsen, 1970). Water-bearing alluvium believed to be Recent in age was found to a depth of 700 feet in a well near the southwest corner of the project area, approximately 1/2 mile west of the Pisgah Fault (Well MM-1, shown on Figure 3.1-5). Alluvium encountered in this area is believed to be Pleistocene through Recent in age. The alluvium consists predominantly of sand, gravelly sand, and clayey or silty sand.

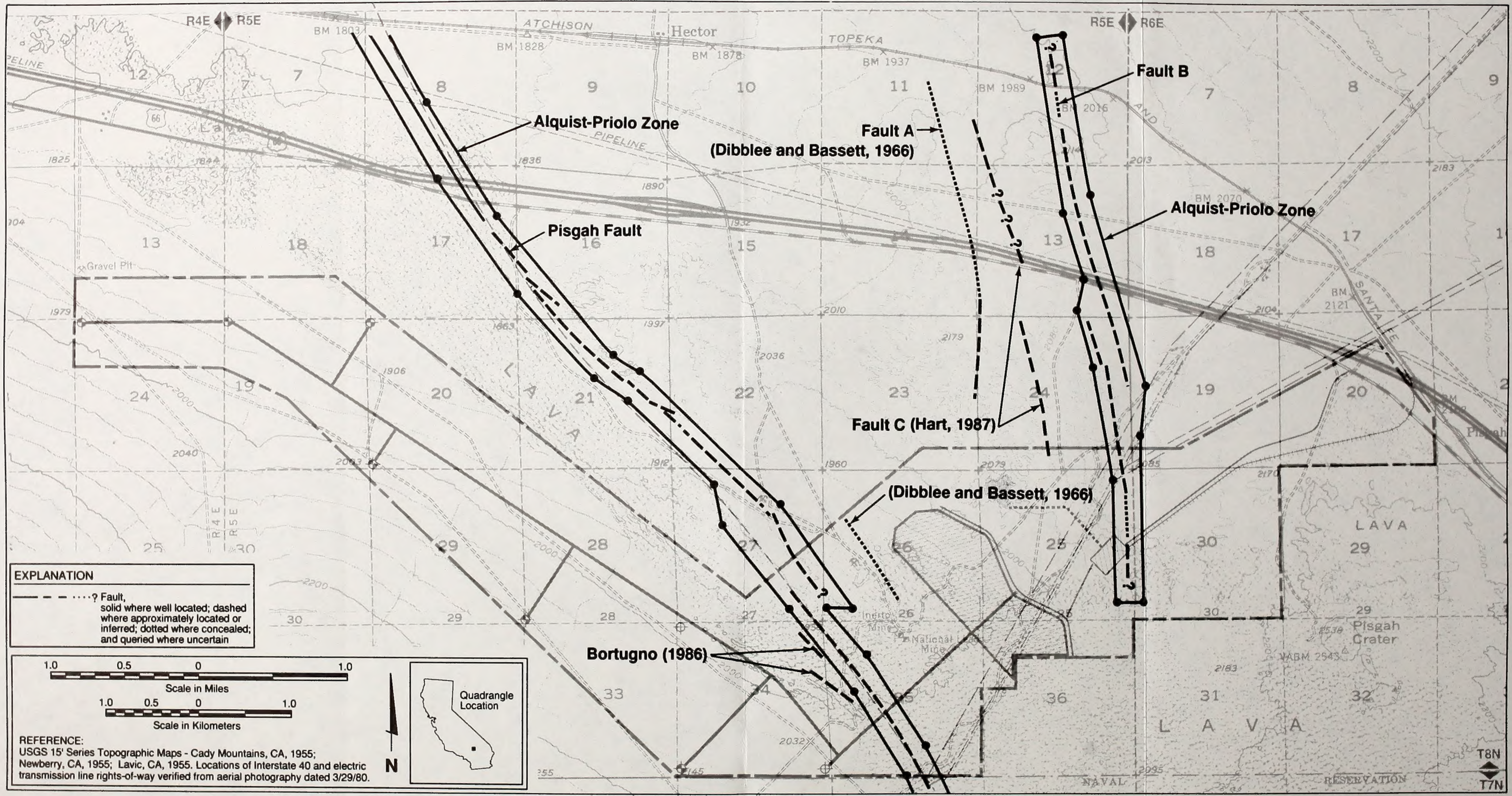
Less is known of the stratigraphy east of Fault B, in the eastern portion of the project area. A well located near the northeast boundary of the project area (Well 8N/6E-20B1, designated Well B-1 on Figure 3.1-5) encountered predominantly sandy and gravelly alluvium to a depth of 700 feet bgs.

3.1.2.6 LOCAL SEISMOTECTONIC SETTING

The project area is transected by several faults; the northwest-trending Pisgah Fault crosses the central portion of the area, and several smaller northwest and north-south trending faults are located in or adjacent to the north-central portion of the project area (Figure 3.1-6). These faults have been evaluated by the CDMG under the Alquist-Priolo Special Studies Zones Act as part of the Mojave Desert study region. The evaluation included a review of available data, aerial photograph interpretation, and selected field checking. The local seismotectonic information in this section was compiled, unless otherwise indicated, from the CDMG Fault Evaluation Report (FER) FER-188 prepared by Hart (1987a, 1987b). Based on this study, zoning was recommended for two faults within the project area, the Pisgah Fault and Fault B (Figure 3.1-6). These faults are discussed in detail below.

3.1.2.7 PROJECT AREA FAULTS

The Pisgah Fault, one of the major northwest-trending faults of the Mojave block, crosses the central portion of the project area; the fault trace is located approximately one-half to one mile southwest of the surface projection of the ore body. This approximately 35-km long, right-lateral fault is believed to connect at depth with the Bullion Fault to the south (Figure 3.1-2). The location of the Pisgah Fault is clearly defined by an alignment of scarps, truncated spurs, closed depressions, and other features suggestive of Holocene displacement. In the vicinity of the project area, the Pisgah Fault is zoned for Special Studies (Alquist-Priolo) from just north of Highway I-40 to just south of the Sunshine crater.



REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

DAMES & MOORE
21864-001-001

FAULTS IN THE PROJECT AREA AND VICINITY

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 3.1-6

Within the project area, the Pisgah Fault is primarily defined by linear scarps and ridges in the Pisgah basalt flow (latest Pleistocene or Holocene in age) and a large closed depression located slightly west of Rheox Corporation mining operations (previously Hector Mine). At this location, the Pisgah Fault trace steps right approximately 1000 feet; the en echelon fault spurs overlap by approximately three-quarters of a mile (Figure 3.1-6). Additional geomorphic features noted by Hart, and observed during an aerial photograph review (1980 photographs provided by Fort Cady Mining Corporation), which also define the fault location within the project vicinity include tonal lineaments in young (possibly Holocene) alluvium, faceted spurs (truncated ridges), and right-laterally deflected drainages.

During regional analyses, Dokka (1983) estimated 6.4 to 14.4 km of combined right-slip for the Pisgah and Rodman faults during the last 20 million years (a long-term slip rate of approximately 0.32 to 0.72 mm/yr). Based on offset units of the Sunshine Cone lava field, located south of the project area, Hart preferred a slip-rate of 0.8 mm/yr during the late Quaternary for the Pisgah Fault. Wesnousky (1986) estimated a moment magnitude of M 6.9 for an earthquake associated with the Pisgah Fault if the fault were to rupture along its entire length. This magnitude, based on a fault length of 34 km, is comparable to surface wave magnitudes of M 7.0 calculated using equations from Slemmons et al. (1989). Based on a preferred slip rate of 1.0 mm/yr, the repeat time of rupture for the Pisgah Fault is estimated to be about 1,700 years (Wesnousky, 1986).

Locally, Miocene and younger-age lake sediments are present on the east side of the Pisgah Fault, while water-bearing alluvium, believed to be Recent in age, was encountered to a depth of 700 feet bgs in a well near the southwest corner of the project area (approximately one mile west of the Pisgah Fault). The juxtaposition of these units suggests an apparent vertical separation of at least 700 feet, with the east block upthrown. Unpublished gravity survey data provided by FCMC for part of the local area confirms the presence of relatively substantial vertical offsets on the Pisgah Fault, as well as the presence of a northwest-trending sedimentary basin just east of the fault. Hart calculated a vertical component of slip of 0.2 mm/yr based on a two meter offset in the basalt near the fault's intersection with Highway I-40. This offset was first identified by Bassett and Kupfer (1963). The young lava was estimated to be approximately 10,000 years old since it appeared unweathered and only weakly varnished.

Limited groundwater elevation data from various sources (Dyer et al., 1963; Subsurface Surveys, Inc., 1990; In-Situ, Inc., 1990; California Department of Water Resources) for wells in the project area vicinity suggested that the Pisgah Fault acts as a groundwater barrier. Although the data are variable, elevations on the west side of the fault are significantly higher (by roughly 100 feet). The observed difference in groundwater elevations across the fault is probably due to the presence of clayey gouge in the Pisgah Fault zone forming a relatively impermeable barrier to groundwater movement.

Several smaller faults have been mapped in the project vicinity. Two north-south trending, unnamed faults, approximately two and three and one-half miles in length, were mapped near the northern boundary of the project area by Dibblee and Bassett (1966). These faults were referred to as faults A and B in the FER (Figure 3.1-6). Fault A was shown as offsetting an older Pleistocene fanglomerate and as concealed by Recent sediments. Fault B, along the eastern portion of the project area, was shown as being entirely concealed by Recent deposits then terminating to the south at the Pisgah basalt. Fault A, not verified by the FER on aerial photographs as a recently active feature, was not recommended for zoning. Evidence observed in the field or during the aerial photograph review for this fault was inconclusive.

Fault B, which was recommended for Special Studies zoning, was mapped by Hart as a ". . . moderately well-defined zone of subtle scarps, sidehill benches, linear drainages and tonal features. . ." with several right-laterally deflected drainages. A linear scarp was mapped at the southern end of Fault B in the basalt lava of the Pisgah flows (latest Pleistocene or Holocene age) along the eastern margin of the project area. This linear scarp, which indicates possible Holocene activity, was observed during field reconnaissance. Based on limited groundwater data and the inferred groundwater barriers formed by similar faults elsewhere in the region, it appears that Fault B may provide some degree of restriction to groundwater movement.

An additional two-and-one-quarter-mile long, north-south trending fault (fault C) was mapped by Hart approximately a half mile west of Fault B (Figure 3.1-6). He described this fault as a ". . .weak zone of degraded or erosional features. . ." in older fan deposits. Hart concluded that although Fault C was probably active during the late Pleistocene, it lacked evidence of Holocene activity. Fault C was not recommended for Special Studies zoning.

Dibblee and Bassett (1966) also mapped a short northwest-trending fault along an alignment of clay outcrops in the northern edge of the Pisgah basalt just east of the Rheox Corporation mine (Figure 3.1-1). This fault could not be discerned in the 1980 aerial photographs reviewed by Dames & Moore and was not evident during their field reconnaissance. In addition, this fault was not noted in the FER by Hart.

In addition to showing the Pisgah Fault and faults A and B, a regional map showing recency of faulting by Bortugno (1986) displays two short northwest-trending faults on the southwest side of the Pisgah Fault (Figure 3.1-6). These faults have been mapped within the Pisgah basalt flow and, if they exist, are probably minor splays of the nearby Pisgah Fault.

A review of the geologic logs for the boreholes drilled during the project area exploration indicated no direct evidence for the presence of substantial vertical separation on faults within the ore body. Approximately 250 feet of relief on the basal volcanic sand and underlying andesite was observed just west of the ore body area (Figure 3.1-4) based on FCMC exploratory boring logs. This relief may represent basin topographic relief existing prior to deposition of the ore-bearing lacustrine sediments, or may represent fault offset.

An additional northwest-trending fault in the vicinity of the project area is the Rodman fault, located approximately four miles southwest of the Pisgah Fault. This 23 km-long fault was included in the FER by Hart (1987a and b). Although this fault is reportedly defined by erosional and fault-line features such as scarps and linear drainages, it is concealed in places by Holocene and Pleistocene deposits. However, apparent drag on stratified units adjacent to the fault suggests significant right-lateral displacement has occurred. Due to the lack of evidence for Holocene activity, and the fact that it is only discontinuously defined as a surface trace, the Rodman fault was not recommended for zoning. Several earthquakes in the vicinity of the fault trace, however, suggest that the Rodman fault may be active at depth.

3.1.2.8 HISTORIC SEISMICITY

Recent earthquakes and instrumental seismicity data from the California Institute of Technology (1985) for well-located earthquakes (A and B quality) indicate that the Mojave block is a seismically active region. The June 28, 1992 magnitude (M) 7.5 Landers earthquake confirms the seismic potential of faults within the Mojave block. This earthquake resulted from seismic rupture of four fault segments with a combined rupture length of approximately 80 km. Preliminary evaluation of the source-time function indicated that the earthquake was characterized by two subevents, probably related to the incremental rupture of adjacent fault segments.

The Landers earthquake occurred on a series of faults which lie to the south and west of the proposed project area. Primary surface rupture took place on the Johnson Valley, Homestead Valley, Emerson and Camp Rock faults. Secondary deformation was typically observed within a zone 20 to 100 feet wide along the primary fault trace. However, significant ground deformation also occurred in areas 0.5 to 2.0 miles wide at major step-overs between the Johnson Valley-Homestead Valley faults, Homestead Valley-Emerson faults and Emerson-Camp Rock faults.

Primary ground rupture was characterized by right-lateral displacements averaging 2 to 3 meters, with maximum displacement of 6.5 meters on the Emerson fault near Besemer Mine Road. The sense of vertical ground deformation was typically consistent with local topographic relief. Observed uplift ranged from 0 to about 1.5 meters, but on average was about 0.5 meters.

Subsidiary ground deformation was also observed on Valley Center Road in Newberry Springs and along the Hector Mine access road. Whether this ground deformation is the result of strong ground motion, or due to local tectonic processes has not yet been determined.

Instrumental seismicity data are available for the period of 1932 to mid-1985; however, the majority of the epicenters recorded in the Mojave Desert region were recorded during the last 15 years when expansion of the seismic network improved the detection and location of earthquakes. Seismicity data for the project vicinity include numerous earthquakes of less than M 4.0. Hart's analysis of the project area seismic data indicated that ". . .three clusters of epicenters lie just east of, and presumably are associated with, the Pisgah Fault and Fault B." This seismicity suggests that these faults may be historically active at depth. An M 5.2 event in 1965 and four smaller events appear to be locationally associated with the nearby Rodman fault.

Hart suggests that some of the events in the project vicinity may be related to former lava aggregate mining at the Pisgah Crater or the hectorite clay mining. In addition, some of the epicenters lie south and east of the Pisgah Crater within the Marine Corps Training Center where numerous explosions occur. However, the events appear to be too widely scattered and probably too large (some are M 3.0 to 3.9) to be man-caused, except for some of the smaller events within the Marine Corps Training Center which could have been generated by high explosives.

3.1.3 GEOLOGIC/SEISMIC DESIGN CONSIDERATIONS

The following sections include general descriptions of geologic, seismic, and hydrologic phenomena that should be considered during the design phase of the proposed action. The purpose of these discussions is to identify these phenomena and briefly summarize their nature and extent.

3.1.3.1 STRONG GROUND MOTION

The project area is located in a seismically active region (see Section 3.1.2.7 and Figure 3.1-2), and proposed facilities may therefore be subjected to strong ground shaking. Strong ground shaking refers to the transitory ground motions induced by the passage of seismic waves. Strong ground motions are typically expressed in terms of peak ground acceleration (amplitude) and duration of shaking. Potential seismic sources include: near-field faults such as the Pisgah Fault, Fault B, and the Rodman fault; distant northwest-trending faults of the Mojave Desert; and further distant major fault zones of Southern California such as the San Andreas, Garlock and Furnace Creek-Death Valley fault zones.

The maximum credible earthquake (MCE) and maximum probable earthquake (MPE) were estimated for the fault zones considered to have the greatest potential to generate earthquakes that would cause significant strong ground motion at the project area (Table 3.1-1). The MCE is the largest earthquake that a fault appears to be capable of generating under present seismotectonic conditions (CDMG Note #43). MCEs were estimated using historical seismicity, published geologic evidence of paleoseismic events, and empirical relationships between fault rupture length and magnitude (Slemmons, 1982; Bonilla and others, 1984; Slemmons et al., 1989) which are based on data from historic earthquakes. The fault rupture lengths used to estimate the MCEs were the longest segments, based on geologic and/or seismic data, which were considered likely to rupture in a single earthquake. However, based on the occurrence of the Landers earthquake, it's apparent that multiple fault segments may rupture concurrently. Therefore, due to this style of earthquake occurrence it is also appropriate to assign a MCE for an event involving the rupture of multiple fault segments within the system of faults that traverse the western Mojave block. The concept of fault segmentation is the subject of professional discussion and evolving thought, but has been widely applied to seismic hazard assessments worldwide.

The MPE earthquake is the earthquake most likely to occur on a fault within a 100-year period, but shall not be lower than the largest earthquake which has occurred on a fault within historic time (CDMG, 1975). MPEs were estimated using fault dimensions, slip rates, and regional seismic parameters and the methods of Molnar (1979) and Wesnousky (1986). A range for the MPEs was selected for the northwest-trending faults of the Mojave Desert due to the general lack of knowledge regarding the long term paleoseismic history of these faults and the uncertainty associated with their dimensions. A recurrence interval of 75 to 150 years was used to select appropriate earthquake magnitudes for the MPEs. It is important to note that although Dames & Moore does consider a M 7.5 event as a MCE for some faults in the western Mojave, based on the occurrence of the Landers earthquake, it is not appropriate to consider the Landers event as the MPE for faults in this system. Several observations suggest that the Landers event was anomalous and not representative of events with short recurrence intervals. These observations include the large amount of displacement and the rupture of multiple fault segments.

The peak ground acceleration in the project area associated with the MCE and MPE for each source fault was estimated using an updated version of the attenuation relationship of Donovan and Becker (1986) (Table 3.1-1). The epicentral distance used for these estimates was the closest distance between the mapped or inferred surface trace of the source fault and the project area. For the Pisgah Fault and Fault B, a distance of 1.0 km was considered reasonable to calculate peak ground accelerations generated from earthquakes associated with these faults. It should be noted that at this close distance, earthquake magnitudes above approximately 6.5 make little difference in the behavior of structures to near-field strong ground motion.

TABLE 3.1-1
ESTIMATED MAXIMUM CREDIBLE EARTHQUAKES (MCE), MAXIMUM PROBABLE EARTHQUAKES (MPE), AND PEAK GROUND ACCELERATIONS FOR MAJOR SEISMIC SOURCES

Fault/Fault Zone	Distance to Project Area (km)	Fault Length (km) (a)	MCE		MPE	
			Magnitude[(b)]	Mean Peak Acceleration	Magnitude	Mean Peak Acceleration
San Andreas	90	300+	8	0.07	8	0.07
Garlock (east)	100	148	7½	0.04	6½	0.02
South Death Valley	100	55	7	0.03	5¾	0.01
Helendale	55	75	7¼	0.08	5-5½	0.02
Lenwood	36	91	7½	0.15	5-5½	0.03-0.04
Camp Rock/Emerson Homestead/Johnson Valley[(c)]	22	80	7.5	0.23	5-5½	0.05-0.07
Calico	10	100	7½	0.38	5-5½	0.10-0.15
Rodman	5.0	16	6¾	0.39	5-5½	0.20-0.23
Pisgah/Bullion	1.0	83	7¼	0.62	5-5½	0.30-0.34
Fault B	1.0	6.4	6¼	0.45	5 (?)	0.27
Ludlow	18	67	7¼	0.24	5-5½	0.07-0.09

Note: (a) Estimated fault lengths used for estimating MCE magnitude are from Wesnousky (1986). Another potentially significant seismic hazard identified for the site is surface fault rupture along the traces of the Pisgah Fault and Fault B. The potential for this hazard is considered to be low, however, and can be minimized by avoiding construction in the immediate vicinity of the fault traces.

Other design considerations identified for the project include seismic settlement and differential compaction, erosion and deposition, and expansive soils. Proper design of project facilities, however, would mitigate these hazards.

(b) MCE based on regression relationship of Slemmons (1989) where $M_s = 5.73 + 0.85 \text{ Log } L$ (L = length in kilometers).

(c) Rupture length and magnitude based on June 28, 1992 Landers earthquake.

3.1.3.2 SURFACE RUPTURE

Surface fault displacement is the sudden and permanent differential movement of the ground surface along the trace of a fault. The project area is dissected by two faults, the Pisgah Fault and Fault B, which are considered to be Holocene-active and sufficiently well defined to warrant zoning under the Alquist-Priolo Act. Consequently, the potential for surface fault rupture exists within the project area along the traces of these faults, but is considered to be low.

3.1.3.3 LIQUEFACTION

Liquefaction occurs when pore-water pressure in loose, saturated, granular soils exceeds confining pressure due to seismically-induced ground movement and the soils lose their strength and behave as a liquid. Liquefaction may cause damage to foundations or other structures. Prerequisite conditions for liquefaction are a shallow water table and loose, cohesionless, granular, fine-grained soils. Information regarding groundwater levels within the project area, provided by FCMC and the Department of Water Resources, indicated depths to groundwater ranging from 145 to 348 feet bgs. Based on these data, the potential for liquefaction is remote.

3.1.3.4 SEISMIC SETTLEMENT AND DIFFERENTIAL COMPACTION

Seismic settlement is the compaction or consolidation of soils as a result of seismically induced ground shaking. Loose, sandy and/or silty soils are typically most susceptible to seismic settlement. Cohesive or clay-rich soils and sediments exhibit little or no settlement as a direct result of strong ground motion. Differential compaction may occur with variation in soil depth, soil density, and severity of ground shaking across the project area. Differential compaction may result in serious damage to structures. Based on available data regarding soil conditions within the project area, the potential for seismic settlement or differential compaction beneath onsite structures is low provided that standard grading operations regarding removal and recompaction of soils are properly implemented. The principal concern for this type of hazard is damage caused to pipelines from differential compaction. Proper design of the pipelines, however, can help mitigate this hazard.

3.1.3.5 LANDSLIDES

Steep slopes, slopes covered with deep soils, and hillsides saturated with water are areas susceptible to landslides. The majority of the project area has very little relief, except for local variations within the lava field. Some gentle slopes are located in the northern portion of the project area; however, evidence of landsliding was not observed in this area during Dames & Moore field reconnaissance. Based on these conditions, the potential for seismically-induced landslides or naturally occurring landslides to adversely affect the project is very low.

3.1.3.6 EROSION AND DEPOSITION

Erosion is the removal and transport of weathered earth material and is followed by deposition of the material at another location or locations. Erosion is generally most severe in areas with (1) unconsolidated soils, (2) steep slopes, (3) sparse vegetation, and (4) rapid runoff.

Erosion and deposition potential within the project area is generally low to moderate, due to the semiconsolidated nature of the soils and the low topographic relief. Areas of relatively high erosion potential are located in the area of washes which are floored by unconsolidated sandy soils. These washes are located in the western portion of the project area south of the lava flow and in the central portion of the project area northeast of the proposed process plant location. The potential for adverse effects on the project are low, except for the proposed water pipelines in the western project area. Proper design of the pipelines, however, can help mitigate this hazard.

3.1.3.7 EXPANSIVE SOILS

Expansive soils are those which greatly increase in volume when they absorb water and shrink when they dry out. Expansion is most often caused by clay minerals, primarily montmorillonite and illite. The volume changes resulting from variable soil moisture conditions can cause damage to structural foundations if proper engineering design is not followed. However, these soils only represent a hazard when they are unrecognized, since mitigation measures have been developed and can be readily implemented.

Project area soils have a predominantly low potential for expansion, due to the low percentage of clay minerals. However, soils in the north-central project area, where gravelly clays are exposed at the surface, have moderate to high potentials for expansion. Proper design of proposed facilities in this area can mitigate this hazard.

3.1.3.8 SUBSIDENCE

Subsidence may occur as a result of several processes, including (1) regional tectonic downwarping, (2) groundwater, oil, or gas withdrawal, (3) hydrocompaction, and (4) subsurface mining operations (e.g., the proposed action). Subsidence in the project area due to tectonic downwarping, fluid withdrawal, or mining operations is not known to be occurring in the project area or vicinity at this time.

Hydrocompaction is a volumetric decrease which occurs as a result of saturation of low density soils. The potential for occurrence of this type of subsidence within the project area is low.

3.1.3.9 OTHER POTENTIAL DESIGN CONSIDERATIONS

Other potential geologic/seismic design considerations include volcanic activity, and earthquake-induced flooding and tsunamis and seiches. Earthquake-induced flooding occurs as a result of catastrophic failure of reservoirs and other surface water bodies, or by blockage of flowing streams. Tsunamis are potentially damaging sea waves generated by earthquakes, sub-marine volcanic explosions, and undersea landslides. Seiches are earthquake-induced waves in a confined body of water such as a lake, reservoir, or bay. Given the location of the project area and the nature of the vicinity, there is no potential for flooding, tsunamis or seiches induced by an earthquake.

The Pisgah basalt flows are considered to be latest Pleistocene or Holocene in age (Dibblee and Bassett, 1966). Hart (1987b) considered the Pisgah flows to be younger than the Sunshine cone basalt flow south of the project area, which was radiometrically dated as 0.138±.018 million years in age. Although historic volcanism has not occurred in the Mojave Desert, the abundance of Pleistocene through Holocene cinder cones and basalt flows in this area suggest that the area may be volcanically active and that the possibility of volcanic activity within the project area within the project lifetime cannot be ruled out.

3.1.3.10 SUMMARY OF GEOLOGIC/SEISMIC DESIGN CONSIDERATIONS

The most significant seismic design consideration for the project is earthquake-induced strong ground motion. The Pisgah Fault has the greatest potential for generating the highest estimated level of strong ground motion at the site. An MCE of **M** 7¼ on the Pisgah Fault would likely produce a peak ground acceleration on the order of 0.62 g and an MPE of **M** 5 to 5-1/2 would likely produce a peak ground acceleration of 0.3 to 0.34 g (Table 3.1-1). A peak ground acceleration on the order of 0.1 g from an MCE or MPE on the San Andreas fault is more likely to occur at the project area within the time frame of the project.

3.1.4 MINERAL RESOURCES

The principal identified mineral resource located in the project area is the evaporite ore body described in the previous section. This ore body lies at a depth of roughly 1,000 to 1,800 feet below the ground surface within the project area and consists primarily of colemanite (calcium borate) and anhydrite (calcium sulfate) interbedded with clay.

Another identified mineral resource within the project area is hectorite clay deposits which are currently being mined within the project area by Rheox Corporation. The hectorite was reportedly found to be interbedded with travertine in the Pisgah Fault area and is believed to have originated as a result of alteration of lake-deposited ash beds by hydrothermal (hot spring) waters. These deposits are believed to be Pliocene in age (Ames, et. al., 1958).

A lava aggregate mining operation was formerly operated by Kiewit Mining Group Inc. at Pisgah Crater, located to the southeast of the project area. The aggregate mining operation is currently inactive.

Ore zone fluids contain elevated concentrations of sodium and potassium, based on chemical analysis of samples collected from two mining area wells in 1981 (Table 3.2-1). Sodium concentrations ranged from 2,700 to 7,500 milligrams/liter (mg/L), which is less than the average seawater sodium concentration of 10,500 mg/L. Potassium concentrations ranged from below laboratory detection limits to 2,400 mg/L, compared to an average seawater concentration of 390 mg/L. These ore zone fluids are contained within the claystone formation as interstitial fluids. Based on the extremely slow well recovery rates following pumping of wells, and the very low permeability values obtained from the formation by hydraulic testing (Section 3.2.2.3), the formation appears to be extremely impermeable. In addition, porosity is likely to be quite low in these older (Pliocene?) mudstones and the volume of fluid available is likely to be relatively small. For these reasons, interstitial ore zone fluids do not appear to constitute an economically viable source of sodium or potassium.

X-ray diffraction analysis of a large number of samples from the ore body indicated that the ore body consists predominantly of calcium borate (colemanite), calcium sulfate (anhydrite), and clays (Rooke, 1982; see Section 3.1.2.5). Relatively small quantities of strontium sulfate (celestite), clinoptilolite (a zeolite mineral), and illite were identified. Available data indicates that only calcium borate and calcium sulfate minerals are sufficiently concentrated within the ore body to be considered to be mineral resources. Hectorite has not been identified within the ore body.

Sand and gravel do not appear to be present within the project area in quantities which would make them economically exploitable. Relatively small amounts of sand will be excavated from the north central project area for use in construction of site facilities. Gravel needed for construction purposes will be obtained from a commercial source.

3.1.5 SOILS

Soils within the project area are generally shallow to moderate in depth and derived predominantly from local poorly-consolidated or unconsolidated sedimentary deposits. Although soils are predominantly shallow, the depth to which plant roots can extend is much greater due to the unconsolidated nature of the underlying rock and/or alluvium.

The predominant soil type within the north-central portion of the project area is clayey gravel with some silt and sand. Areas of deeper, more permeable sand and sandy gravel soil formed on alluvium are found in the wash areas, and areas of windblown sand are found throughout the basalt flow area. Although the soils tend to contain a significant proportion of coarse material, except in the larger washes and in the areas of windblown sand on the basalt flow, they typically contain a significant portion of clay and silt sized material derived from the exposed mudstones underlying much of the project area. The fine-grained soil components lower the soil permeabilities and increase runoff. Clayey soils in this area are moderately to very expansive.

The predominant soil type within the eastern and western portions of the project area is sand and gravelly sand. Fines are present but generally limited to a relatively small percentage of the total. Soils in these areas are of low expansivity.

In general, soils within the north-central project area have high runoff potential and relatively low infiltration rates when wetted. These soils also have a very slow rate of water transmission. More permeable soils within the project area include the alluvial sand and sandy gravel soils found in the larger washes and the windblown sand areas within the basalt flows, as well as the sandy soils in the western and eastern parts of the project area.

3.2 HYDROLOGY

3.2.1 SURFACE WATER

3.2.1.1 REGIONAL SURFACE WATER HYDROLOGY

The project area is located in a southeast projection of the Barstow Valley, approximately 35 miles east of Barstow, and approximately two miles south of the local valley surface drainage axis. Drainage within this valley generally follows the topographic gradients towards the valley axis and then flows roughly westward to northwestward into the Barstow Valley to the northwest in the vicinity of Troy Lake.

3.2.1.2 PROJECT AREA SURFACE WATER HYDROLOGY

The western portion of the project area encompasses part of the northeast-directed drainage from the Rodman and Lava Bed Mountains, which are located south and southwest of the project area. This drainage is diverted for the most part to the northwest and into a drainage that parallels the south margin of the basalt flows that cover the southern portion of the project area. It is probable that some of this drainage moves beneath the basalt flow and empties into a second drainage that runs along the north margin of the basalt flow. The south slopes of the low hills in the north-central portion of the project area also drain generally southward to southwestward into the wash that runs along the north flow margin. The area covered with basalt in the south central portion of the project area also drains into these two washes. The washes that parallel the basalt flow in the western project area drain to the northwest, eventually emptying the valley axis drainage approximately two miles northwest of the project area.

The other principal drainage encompasses the eastern portion of the project area. Drainage from this area generally empties northward to northwestward into a wash which joins the valley axis drainage north of the project area.

Surface water within the project area is limited to ephemeral flow in the washes described above and a number of smaller subordinate washes and to ephemeral ponded water in several low areas in the central portion of the project area. No-flow conditions were observed in the project area drainages during hydrologic investigations conducted in November, 1991. No-flow conditions are expected to exist within the project area for most of the year, with flow occurring only during and immediately following periods of heavy precipitation. Ponding of water was observed in several small closed depressions in the central part of the project area in November, 1991, most likely due to recent precipitation. Evidence of recent ponding of water was also observed along the drainage at the north margin of the basalt flow in the west-central portion of the project area. Pooling of water is expected to be dependent upon the amount of precipitation, the evaporation rate, and the permeability of the subsurface materials. Areas of ephemeral ponded water within the project area appear to be limited to areas where low-permeability clay soils are exposed at the surface.

It has been reported that shallow, low-volume seepage has been found to be present near the Rheox Mine, in the south central project area. Much of this seepage is believed to be related to movement of surface water beneath the basalt flow that covers this area.

3.2.1.3 FLOOD HAZARD

The drainages located within the project area, described in the previous section, are all relatively minor drainages. As described above, the western portion of the project area intercepts drainage from the north flanks of the Rodman and Lava Bed Mountains to the south and southwest of the project area. The remaining two drainages are more local, draining the lava flow area and the low hills in the central and eastern portions of the project area.

Flash flooding and sheet flow during periods of intense precipitation are common flood hazards throughout the Mojave Desert area. The drainage south of the lava flow, in the western portion of the project area, has the highest potential for this type of flooding, due to the relatively large catchment area in the mountains to the south and southwest. There appears to be a relatively low potential for severe flooding elsewhere within the project area, due to the small areas encompassed by the drainages in those areas.

Ponding of water in low areas along the Pisgah fault is also likely to occur during periods of heavy precipitation, due to the disruption of drainage patterns that is the result of movement along the fault.

3.2.2 GROUNDWATER

3.2.2.1 REGIONAL OVERVIEW

The project area is situated within the central Mojave, lying in part within an area of structurally uplifted fine-grained lacustrine (lake bed) sediments that are not generally considered to be waterbearing, due to low permeabilities of the sediments (see Section 3.1). The central portion of the project area lies within this uplifted block, which is bounded on the west and east by active faults. The western portion of the project area lies within the southeastern end of a basin designated by the Mojave Water Agency as the Newberry groundwater basin. The eastern jurisdictional boundary of the Mojave Water Agency borders the project area on the west. The Newberry basin is bounded by the Cady Mountains and the Pisgah fault on the east, the Manix fault on the north, the Calico-Newberry fault and the Newberry Mountains on the west, and the Lava Bed and Rodman Mountains on the south. The easternmost portion of the project area is underlain by predominantly coarse-grained alluvium, which is separated by a fault from the block of fine-grained sediments comprising the central project area.

Sediments in regional basin aquifers are predominantly composed of continental alluvial and lacustrine clastic sediments. Except in lacustrine clay and evaporite deposits, grain sizes are generally sand size or larger, although the sediments are not generally well sorted except where locally reworked by streams and rivers. Decomposition of feldspars present in the dominantly arkosic sediments produces diagenetic clays which act to reduce porosity and permeability. Permeabilities thus vary widely throughout the region, with the highest values found in Recent river and large stream deposits and the lowest values in lacustrine (lake bed) clay deposits.

Regionally, the near-surface aquifer is unconfined over most of the central Mojave area (Subsurface Surveys, Inc., 1990). The presence of some perched water tables has been demonstrated, generally in connection with local Pleistocene clay lake deposits that hold water near the surface. The lacustrine clays reportedly serve as confining layers for deeper aquifers throughout much of the western Newberry basin (CM Engineering Associates, Inc., 1982). Where faults provide barriers to groundwater flow, water may also come to the surface locally.

The depth to groundwater in the central Mojave area varies from near surface in perched groundwater areas associated with some lake beds to over 500 feet below ground surface (bgs) adjacent to bedrock areas at basin margins (Subsurface Surveys, Inc., 1990). In the Newberry basin, groundwater depths from roughly 50 feet to over 200 feet have been reported, with depths to groundwater generally increasing southward with distance from the Mojave River.

In general, groundwater flow within the central and southern Newberry basin is directed from the principal basin recharge area, the Mojave River channel, towards the south and southeast (Subsurface Surveys, Inc., 1990). Very limited groundwater elevation data are available for the southeast portion of the Newberry basin, and thus groundwater flow directions in this area are not known.

Fault gouge, which has developed along area faults, reportedly tends to produce effective barriers to groundwater movement. These barriers are believed to be better developed in basin sediments than in bedrock in the region (Subsurface Surveys, Inc., 1990). There is good evidence that the Calico-Newberry fault, for instance, acts as a barrier to groundwater flow, presumably due to the presence of fault gouge. Similar impediments associated with the Helendale and Lockhart faults have been documented (Subsurface Surveys, Inc., 1990).

The groundwater stored in the central Mojave basins is not entirely usable. Specific yields reportedly vary from 15 percent for better aquifers to 3 percent or less for lacustrine clays. The average specific yield is believed to be about 10 percent (Subsurface Surveys, Inc., 1990). In addition, much of the deeper water is unusable due to the high concentration of total dissolved solids, fluorine, and boron; particularly water contained in the deeper, semi-stagnant, closed sub-basins and water associated with buried evaporites (Subsurface Surveys, Inc., 1990). Many sources consider the Pliocene and older sediments to be essentially non-waterbearing, due to porosity reduction by compaction and cementation (diagenesis) (Subsurface Surveys, Inc., 1990).

Recharge in the region is believed to occur principally from the Mojave River and smaller tributaries. Local rainfall ranges from approximately 10 inches per year in the mountains to less than 4 inches per year in the lower valleys. The amount of recharge resulting from infiltration of precipitation from the ground surface is not known.

3.2.2.2 OVERVIEW OF PROJECT AREA HYDROGEOLOGY

The central portion of the project area lies in a block of structurally uplifted Cenozoic lacustrine mudstones, which locally enclose a body of mudstone interbedded with carbonates and evaporites that include the colemanite ore body. This block, which is bounded by the Pisgah fault on the west and an unnamed north-south trending fault located near the eastern project area boundary (designated Fault B on Figure 3.1-2) on the east, is not generally considered to be waterbearing due to the low porosity and permeability of the rock. This is confirmed by hydraulic conductivity values from wells in the project area as described in the following section.

The depth of the fine-grained sediments was found to range from roughly 1,400 to over 1,800 feet in a series of exploratory borings drilled in the central portion of the project area. Volcaniclastic sandstone was encountered below the mudstone in several of these borings, and andesitic volcanic rock was encountered in the bottom of two borings at depths of 1,443 and 1,659 feet.

West of the Pisgah fault, in the western portion of the project area, is the southeastern end of the Newberry groundwater basin. Drillers' logs from FCMC water supply well MM-1 (shown on Figure 3.1-5), located within this basin, in the southwestern part of the project area 1/2 mile west of the Pisgah fault, indicate that sand and clayey sand alluvium are present to a depth of at least 700 feet. Deeper subsurface information from this area is not available. Gravity survey data from the southeastern Newberry groundwater area west of the project area indicate that at least 2,000 feet of sediments are present in the vicinity of Troy Lake, approximately 2-1/2 miles northwest of the project area (Subsurface Surveys, Inc., 1990).

East of Fault B, which transects the eastern portion of the project area, generally coarse alluvium appears to be present to a depth of at least 700 feet. Drillers logs from a water supply well located near the northeast boundary of the project area (Well 8N/6E-20B1, designated Well B-1 on Figure 3.1-5) were provided by the State of California Department of Water Resources (DWR) and indicate the presence of sand to boulder-sized sediments, with very minor clay, to the 700-foot depth of the boring. Deeper subsurface information was not available from this area.

3.2.2.3 CENTRAL PROJECT AREA HYDROLOGY

For purposes of describing the project area hydrology and water quality, the area lying between the Pisgah fault and Fault B, as discussed in the previous section, is designated the central project area. This area is composed of an uplifted block of fine-grained lacustrine mudstone, which encloses the ore body at depth.

Indications of the presence of perched groundwater within the central project area were not found during drilling of exploratory borings into the ore zone area, according to boring logs provided by FCMC. Seepage has been reported within the Rheox, Inc. mine works located in the south central portion of the project area. Much of this seepage is believed to result from movement of surface water beneath the basalt flow that covers the area. Seepage at deeper levels is also to be expected due to the presence of highly impermeable layers, such as zeolitized tuffs and impermeable clay horizons present in the claystone underlying the central project area.

Groundwater level information from within the central project area was provided by FCMC and the DWR. A round of groundwater level measurements was obtained from seven project area test wells in February 1990 prior to beginning hydrologic testing. Wide variation was observed in the depth to groundwater in the wells, which ranged from approximately 145 to 348 feet bgs, which is approximately 1,664 to 1,840 feet mean sea level (MSL). All but two of the wells, however, had reported depths to groundwater of over 300 feet (In-Situ, Inc., 1990). Groundwater elevations in wells with available surveyed elevations ranged from 1,634 feet to 1,691 feet MSL. Groundwater elevations obtained from four of the wells in March, 1992 ranged from approximately 1,672 to 1,699 feet MSL (283 to 308 feet bgs). The wells are within a maximum of less than 1/2 mile from one another, but because the wells are not completed within the same intervals, the variations in depth to groundwater may be an indication of poor vertical hydraulic communication between intervals in the sediments. This is consistent with the observed presence of significant clay layers throughout even the evaporite-rich portions of the ore body. Some of the variations are also believed to be attributable to the local lack of equilibration of groundwater levels following well installation and well pumping and injection. As discussed below, permeability of the formation is very low and wells completed within the ore body have been observed to require months to reequilibrate following injection or pumping.

A multiple-well constant rate injection test was conducted at the project well field area in 1990 by In-Situ, Inc. to evaluate the hydraulic properties of the ore body. The testing involved seven wells, all within a maximum of less than 1/2 mile from one another and screened within the clay/evaporite ore zone. Results of the testing indicated that the inherent permeability of the ore body is very low, between 3 to 8 millidarcies (md). These values correspond well with hydrologic testing performed in 1983 that yielded a calculated inherent permeability for the formation of 4.4 md (Pennzoil Company, 1984). Permeability enhancement in the vicinity of the pilot test area well bores was evident as a result of the In-Situ, Inc. testing, and local permeability barriers and lack of homogeneity in ore body permeability were demonstrated. Permeability barriers sufficiently effective to cause two of the wells to show no response at all were indicated by the data (In-Situ, Inc., 1990). The test data, however, were insufficient to allow further evaluation of the permeability barriers, which can most likely be attributed to lack of homogeneity of the formation.

3.2.2.4 WESTERN PROJECT AREA HYDROLOGY

The western project area is defined, for discussion of the project area hydrology, as that portion of the project area that lies west of the Pisgah fault. This area lies within the southeastern extension of the Newberry groundwater basin, as discussed previously. The proposed action water supply wells are located within this area.

Little groundwater elevation data are available in the western project area vicinity, due in part to the scarcity of active wells. Information provided in a recent regional study conducted for the Mojave Water Agency indicates that groundwater approximately 2-1/2 miles northwest of the project area occurs at a depth of roughly 100 feet bgs (Subsurface Surveys, Inc., 1990). Information from California Division of Mines and Geology (CDMG) Fault Evaluation Report FER-188 indicated that groundwater was found in well 8N/5E-19R1 (designated R-1 on Figure 3.1-5) at 1,780 to 1,790 feet MSL (approximately 100 to 110 feet bgs). This well is located near the western end of the project area. Information was provided by the DWR for well 8N/5E-34Z1, located west of the Pisgah fault near the southwest corner of the project area. (This well is located within Section 34, but is not depicted on Figure 3.1-5, as further information regarding the well location was not provided by the DWR). Well 8N/5E-34Z1 is reportedly 350 feet deep and screened over the interval 150 to 350 bgs. Water depth in the well was reportedly 172 feet bgs (1,803 feet MSL). A third well, FCMC well MM-1, is located near the south boundary of the project area, approximately 1/2 mile west of the Pisgah fault, and is screened from 300 to 700 feet bgs. The static water level was reported to be 275 feet bgs (1,785 feet MSL) in the well at the time of well installation in 1982 and 263 feet bgs (1,807 feet MSL) in February 1992. A fourth well, FCMC well MM-2 (also shown on Figure 3.1-5) is located approximately 1 mile northwest of well MM-1 (Figure 3.1-5). The groundwater level in this well was reported to be 202 feet bgs (approximately 1,928 feet MSL) in September 1991.

Groundwater elevations appear to differ significantly across the Pisgah fault, seeming to be significantly lower east of the fault, although this is based on relatively limited data. The difference in groundwater levels across the fault appears to be roughly 100 feet or more. The data from wells on both sides of the Pisgah fault in the project area vicinity were variable. Because not all the groundwater level information provided was accompanied with the dates measurements were obtained, it is possible that some of the variations may be due to temporal variations in groundwater levels. However, this observed difference in groundwater elevations across the Pisgah fault is most likely due to the presence of clayey gouge in the Pisgah fault zone forming a relatively impermeable barrier to groundwater movement. This effect has been noted in other basins in the region where faults reportedly form effective barriers to groundwater flow, based on similar differences in groundwater level.

EVALUATION OF SAFE YIELD

The safe yield of an aquifer is the rate at which groundwater can be withdrawn without causing a long-term decline of the water table or piezometric surface. Thus, the safe yield is equal to the replenishment rate of the aquifer (Bouwer, 1978). Within the western project area and vicinity, the safe yield was estimated, as described below, through the replenishment rate upgradient from the planned supply well network area.

In the vicinity of the proposed supply well network, insufficient well data exist to allow evaluation of groundwater gradients. However, the topography suggests that the predominant groundwater flow direction is southeasterly, toward the Pisgah fault. As discussed above, the Pisgah fault appears to function as a relatively impermeable barrier to groundwater flow between the proposed supply well network area and the lower elevation area to the southeast.

As shown on Figure 3.1-5, the planned supply well network area is located slightly upgradient from the Pisgah fault zone. The catchment area upgradient from the planned supply well network was estimated to be approximately 23 square miles. For the purpose of estimation of aquifer recharge, the catchment area was subdivided into two zones: a headwater (higher elevation) zone within the Rodman and Lava Bed Mountains and their immediately adjacent alluvial fans, located to the southwest of the supply well network area, and a lower elevation zone, located downgradient from the headwater zone and adjacent to the supply well network. The headwater zone comprises approximately 18.8 square miles situated at elevations averaging roughly 3,500 feet above MSL and ranging between 2,280 feet and 4,120 feet above MSL . The average annual precipitation in the higher parts of the Newberry Mountains, west of the project area, has been estimated at approximately 10 inches. A conservative annual average of 7 inches of rainfall has been used for the headwater zone in these calculations. The lower elevation zone comprises approximately 5 square miles, situated at elevations between 2,000 feet and 2,280 feet above MSL. Being in a relatively low topographic elevation area the annual precipitation average was estimated at 4 inches in this zone.

The annual recharge rate within the catchment area is not known. However a conservative estimate for the recharge rate of between 2 to 5 percent of the annual precipitation rate has been used to evaluate the safe yield. That at least this much recharge occurs in this part of the basin is consistent with the following evidence:

- The total dissolved solids concentration (in the vicinity of 1,000 to 2,000 mg/L) in the groundwater in the supply well network area (see Section 3.2.2.6);
- The relatively low evaporation rate during the winter when most of the annual precipitation occurs; and
- The relatively permeable sand and gravel which underlies the proposed supply well network area and vicinity, as well as the numerous sandy and gravelly washes in the alluvial fan upgradient of the supply well network, allowing precipitation to infiltrate to the groundwater within a reasonably short period of time.

The safe yield of the supply well network area aquifer was calculated using the following formula:

$$S_y = \overset{n}{\underset{i=1}{Z}} f_i A_i R_i \qquad (1)$$

where S_y = Safe yield
f_i = Fraction of annual rainfall which recharges groundwater in area i
A_i = Area of area i
R_i = Mean annual precipitation in area i

Based on the information cited previously, the range of safe yield was calculated using Equation (1) to be:

Recharge Rate (Percent of annual precipitation)	Safe Yield (Acre-feet)
2	163
5	405

The calculated estimate of the annual average safe yield for the area of the southeastern Newberry groundwater basin in which the proposed supply well network is located thus ranges from 163 to 405 acre-feet. There is a relatively high level of uncertainty associated with these estimates, which are based on very limited data. Also, little is known about subsurface flow into or out of the groundwater basin. Groundwater levels tend to be higher to the northwest, suggesting that groundwater moves from that area into the part of the basin underlying the proposed well network, providing additional recharge. It is possible that groundwater may be very slowly infiltrating across the Pisgah fault zone from the basin area on the west into the adjacent mudstone formation. However, the relatively low TDS concentrations of the local Newberry basin groundwater suggest that little infiltration from the mudstone unit into the basin area occurs. Other areas of uncertainty involve average precipitation amounts in the catchment area and local infiltration rates.

EVALUATION OF AQUIFER PROPERTIES

Prior to evaluating the hydrogeologic impacts resulting from groundwater extraction from the planned supply well network, the hydraulic properties of the supply well network area aquifer were assessed. A steady-state pumping test was conducted at well MM-1 (within the supply well network). An extraction rate of 250 gallons per minute (gpm) and a steady-state drawdown of 77 feet were reported. The radius of the well is reportedly 8 inches and the well casing is perforated between 300 and 700 feet bgs. The initial water table was reported to be 275 feet below the top of the casing.

The range of hydraulic conductivity values was calculated using the following equation (Bouwer, 1978).

$$K = \frac{Q}{\pi} \quad \frac{1}{(h_o^2 - h_w^2)} \quad \ln \frac{(r_o)}{(r_w)} \tag{2}$$

Where K = Hydraulic conductivity
Q = Extraction rate
h_o = Saturated thickness at radius r_o
h_w = Saturated thickness at the well screen
r_o = Radial distance from the well casing axis where drawdown is negligible (radius of influence)
r_w = Well radius

Based on a conservative assumption that the thickness of the permeable alluvium is 700 feet, which implies that the initial saturated thickness (and h_o) is equal to 425 feet, equation (2) was used to evaluate the value of hydraulic conductivity of the aquifer. The radius of influence was not known and assumed to range from 400 feet to 2,500 feet. Using equation (2) the value of hydraulic conductivity of the aquifer was estimated to vary between 1.64 feet/day (599 millidarcies) (for r_o = 400 feet) and 2.1 feet/day (767 millidarcies) (for r_o = 2,500 feet). It is apparent that the value of hydraulic conductivity is relatively insensitive to variation of the radius of influence. This range of hydraulic conductivity values is consistent with the ranges cited as typical values for hydraulic conductivity in silty sands and fine to medium-grained clean sands (Freeze and Cherry, 1979).

3.2.2.5 EASTERN PROJECT AREA HYDROLOGY

For purposes of the following discussion, the eastern project area is defined as that portion of the project area lying east of the unnamed Fault B, as shown on Figure 3.1-6. DWR was able to furnish groundwater elevation data for one well east of the Pisgah fault in the project area vicinity. This well, 8N/6E-20B01 (designated B-1 on Figure 3.1-5) is located just north of the northeastern corner of the project area, approximately 1-1/2-miles east of Fault B. The well is reportedly 701 feet deep and screened from 383 to 682 feet bgs. Groundwater was reportedly 410 feet bgs in this well (at an elevation of 1,670 feet MSL), but the date of the measurement was not provided. This groundwater elevation is roughly comparable to groundwater elevations reported in wells on the west side of Fault B, within the central project area. However, the surface elevation is somewhat higher and thus the reported depth to groundwater in the well on the east side of the fault, 410 feet, is considerably greater than beneath the well field in the central project area, where wells had reported depths to groundwater ranging from approximately 145 to 348 feet bgs. Based on this, and the inferred groundwater barriers formed by similar faults elsewhere in the region, it is probable that Fault B also provides some degree of restriction to movement of groundwater. This seems particularly likely due to the presence of abundant clay-rich sediments on the west side of the fault, which tend to form a particularly impermeable gouge in fault zones.

3.2.2.6 GROUNDWATER QUALITY

Groundwater quality in the project area and vicinity is generally poor, based on data reviewed. Most groundwater samples exceeded the recommended drinking water standards of 1,000 milligrams per liter (mg/L) for Total Dissolved Solids (TDS) and 1 mg/L for boron. Review of DWR data indicates that fluoride concentrations also exceed recommended standards in the southeast Newberry groundwater basin (western project area).

CENTRAL PROJECT AREA

Chemical analysis of seepage water from the upper part of the claystone in this area was not available, but relatively high TDS concentrations are to be expected based on the observed presence of evaporite minerals in shallow near-surface and surface sediments in the central project area.

Analysis of formation water extracted from the ore (mining) zone wells indicates that the fluid is, as would be expected, highly saline, with TDS concentrations ranging from 23,300 to 29,800 milligrams per liter (mg/L) in Well SMT-1 over the period March 1981 through April 1981. A sample taken from Well P-2 in July 1987 had a TDS content of 25,400 mg/L and boron was reported at 530 mg/L. Computer modeling of the chemical parameters of the water from two of the ore zone wells (described more fully in Section 4.1.2) indicates that the ore zone fluids were supersaturated with respect to anhydrite, gypsum, calcite, and aragonite. Supersaturation with respect to dolomite and celestite were also reported in some of the samples. It is believed that the ore zone fluids are also saturated to supersaturated with respect to colemanite. Higher TDS values have been reported from other fluid samples obtained from the ore zone area. As discussed in Section 4.1.2, these higher TDS samples were collected during or following pilot mining tests and are believed to represent injected acidic solution that remained in the well area.

Water quality information for two wells located on the east side of the Pisgah fault and north of the project area, but west of Fault B, was provided by the DWR. Well 8N/5E-01P01 is located approximately 3 miles north of the project area, adjacent to Fault B. According to records provided by the DWR the well was last sampled in 1952 and had a reported TDS of 1,721 mg/L. Boring log information was not provided for this well. A second well, 8N/5E-16C01 (depicted as C-1 on Figure 3.1-5), located approximately 1-1/2 mile northeast of the northwest project area, was last sampled in 1957 and had a reported TDS of 278 mg/L. This well is located just southeast of a USGS boring that encountered predominantly fine-grained sediments to a depth of approximately 250 feet and sandstone and conglomerate between 650 feet and 700 feet. The remainder of the boring was unlogged. Groundwater in these areas does not appear to be significantly influenced by the evaporitic minerals in the area of the ore body. Well 8N/5E-16C01 appears to be located outside the area of fine-grained lacustrine sediments, based on boring log information from the nearby boring.

WESTERN PROJECT AREA

Water quality information provided by FCMC from Well MM-1, located within the project area approximately 1/2 mile west of the Pisgah fault, within the southeastern Newberry groundwater basin, indicated that the TDS content ranged from 1,640 to 1,974 mg/L in four sampling events during 1982. The well was sampled again in 1991 and yielded a TDS content of 1,440 mg/L. The fluoride content was 1 mg/L in 1982 and the boron content ranged from an average of 5 mg/L in the 1982 samples to 11.03 mg/L in 1991. Nitrate ranged from 12 mg/L to 32 mg/L and sulfate ranged from 830 mg/L to 1,200 mg/L. Above-regulatory standards for TDS, boron, and sulfate were reported in samples from the well. This well is 700 feet deep and is screened from 300 to 700 feet bgs.

The DWR provided water quality information for three wells located on the west side of the Pisgah fault, southeast of Troy Lake. The wells were located approximately 2 miles west of the fault and 1-1/2 miles northwest of the project area. Sampling dates provided ranged from 1954 to 1977. Reported TDS values ranged from 1,094 to 1,472 mg/L, all exceeding the recommended drinking water standard. Groundwater south and west of Troy lake is historically reported to have TDS concentrations of less than 600 mg/L, but boron and fluoride levels reported by the DWR have exceeded recommended levels for drinking water.

EASTERN PROJECT AREA

No water quality data from the well located east of Fault B were available from the DWR.

3.2.2.7 PROJECT AREA HYDROLOGIC UNITS

The information reviewed for this study indicates that the project area contains several discrete hydrogeologic units. The southeastern end of the Newberry groundwater basin is located in the western project area and contains groundwater which is usable primarily for industrial purposes due to relatively high TDS and boron content. The ore body is located within a body of relatively impermeable mudstone in the central project area which is separated from the southeastern Newberry basin by the Pisgah fault. That the Pisgah fault forms a relatively impermeable barrier to movement of groundwater between the two units on either side is demonstrated by the significant difference in groundwater elevations across the fault (generally over approximately 100 feet) and the significant differences in groundwater chemistry in samples from wells on either side of the fault (Table 3.2-1). While samples from wells in the central project area have TDS concentrations in the range of 23,000 to 29,800 ppm, samples from well MM-1 just west of the Pisgah fault have had TDS concentrations in the range of 1,440 to 1,974 ppm. The concentrations of the constituents calcium and sodium, as well as TDS, were 11 to 15 times higher in the ore body fluids, on the average, compared to samples from well MM-1. Potassium was over 100 times higher and boron concentrations over 300 times higher in the ore fluid, magnesium concentrations were approximately the same, and the nitrate concentration was approximately 10 times lower in the ore body fluid than in samples from well MM-1.

The degree of hydraulic continuity between the ore body area and the areas to the north and south, east of the Pisgah fault cannot be evaluated on the basis of existing groundwater data, as wells are not located in these areas. Boring logs have demonstrated continuity of evaporites interbedded with mudstone to the northwest, as described in Section 3.1. Lake bed sediments, because of the limited areas in which they are deposited, are generally of relatively limited extent, grading into coarser clastic sediments of the lake basin margin. Thus, it is probable that the mudstone enclosing the ore body "pinches out" against coarser clastic sediments both to the northwest and southeast of the project site. Permeability within the ore body formation has been demonstrated to be extremely low (Section 3.2.2.3), and permeability of the enclosing mudstone is expected to

TABLE 3.2-1
ANALYSIS OF GROUNDWATER SAMPLES

Well No.	SMT-1 (Mining Area)					P-2 (Mining Area)	MM-1 (West of Pisgah Fault)				
Date	3/81	3/81	4/2/81	4/2/81	4/4/81	7/2/87	2/8/82	2/8/82	2/9/82	2/9/82	4/2/91
TEMPERATURE, °C	-	-	-	-	-	-	-	-	28	28	-
pH, units	8.57	8.27	8.48	8.23	8.84	8.13	7.52	7.3	7.6	7.6	8.5
TDS, mg/L	29,800	-	25,300	-	23,300	25,400	1,860	1,640	1,974	1,944	1,440
CONDUCTIVITY, mmhos/cm	-	-	-	-	-	-	2,800	2,180	2,800	2,800	2,030
ALUMINUM, mg/L	-	-	-	-	-	22	-	-	-	-	-
ARSENIC, mg/L	-	-	-	-	-	-	-	0.03	-	-	-
BARIUM, mg/L	-	-	-	-	-	-	1	ND	1	1	-
BICARBONATE, mg/L	-	468	-	82	-	1010	115	116	122	122	-
CARBONATE, mg/L	100	288	120	437	120	-	-	-	-	-	-
BORON, mg/L	-	-	-	-	-	2,200	5	6	5	5	11.03
BORATE (B_20_3), mg/L	2,360	-	2,840	3,059	2,360	-	-	-	-	-	-
BORATE (HBO_3) (WET), mg/L	-	-	-	-	-	5,776	-	-	-	-	-
CADMIUM, mg/L	-	-	-	-	-	-	-	ND	-	-	-
CALCIUM, mg/L	786	666	664	617	648	2,900	98	108	104	102	49
CALCIUM (WET), mg/L	-	-	-	-	-	530	-	-	-	-	-

TABLE 3.2-1 (CONTINUED)
ANALYSIS OF GROUNDWATER SAMPLES

Well No.	SMT-1 (Mining Area)					P-2 (Mining Area)	MM-1 (West of Pisgah Fault)				
Date	3/81	3/81	4/2/81	4/2/81	4/4/81	7/2/87	2/8/82	2/8/82	2/9/82	2/9/82	4/2/91
CARBON DIOXIDE, mg/L	-	-	-	-	-	-	3.5	-	4.4	3.5	-
CHLORIDE, mg/L	-	3,925	1,200	2,925	3,200	-	61	60	61	59	65
CHLORIDE, (WET), mg/L	-	-	-	-	-	920	-	-	-	-	-
CHROMIUM, mg/L	-	-	-	0.07	-	-	-	0.01	-	-	-
COPPER, mg/L	-	-	-	-	-	1.2	-	0.01	-	-	-
FLUORIDE, mg/L	-	-	-	-	-	-	-	1	-	-	-
IRON, mg/L	6.3	-	ND	0.01	ND	57	0.15	0.1	0.23	0.25	ND
LEAD, mg/L	-	-	-	-	-	-	-	0.02	-	-	-
LITHIUM, mg/L	91	-	47	-	29.9	77	-	-	-	-	-
MAGNESIUM, mg/L	11.4	ND	11.8	ND	8.3	50	14	12	17	14	-
MAGNESIUM (WET), mg/L	-	-	-	-	-	12	-	-	-	-	-
MANGANESE, mg/L	-	-	-	-	-	8.3	-	0.01	-	-	-
MERCURY, mg/L	-	-	-	-	-	-	-	ND	-	-	-
NICKEL, mg/L	-	-	-	-	-	7.3	-	-	-	-	-
NITRATE, mg/L	-	-	-	1.8	-	-	12	32	15	15	-
PHOSPHATE, mg/L	-	-	-	10	-	-	-	-	-	-	-
POTASSIUM, mg/L	2,400	-	524	275	1,200	ND	-	10	-	-	5.6
SELENIUM, mg/L	-	-	-	-	-	-	-	ND	-	-	-

TABLE 3.2-1 (CONTINUED)
ANALYSIS OF GROUNDWATER SAMPLES

Well No.	SMT-1 (Mining Area)					P-2 (Mining Area)	MM-1 (West of Pisgah Fault)				
Date	3/81	3/81	4/2/81	4/2/81	4/4/81	7/2/87	2/8/82	2/8/82	2/9/82	2/9/82	4/2/91
SILICA OXIDE, mg/L	-	-	-	18	-	-	-	-	-	-	-
SILICON, mg/L	-	-	-	-	-	1,300	-	-	-	-	-
SILVER, mg/L	-	-	-	-	-	-	-	ND	-	-	-
SODIUM, mg/L	7,500	6,485	5,900	3,934	5,300	2,700	445	375	503	500	450
SODIUM (WET), mg/L	-	-	-	-	-	6,400	-	-	-	-	-
STRONTIUM, mg/L	-	-	-	-	-	570	-	0.03	-	-	-
SULFATE, mg/L	-	-	-	-	-	-	1,060	900	1,200	1,180	830
SULFATE (WET), mg/L	11,700	9,000	13,100	10,100	11,400	13,460	-	-	-	-	-
TIN, mg/L	-	-	-	-	-	47	-	-	-	-	-
ZINC, mg/L	-	-	-	-	-	-	-	0.03	-	-	-
TOTAL ALKALINITY, mg/L	-	-	-	-	-	-	-	95	-	-	-
HARDNESS, mg/L	-	-	-	-	-	-	300	320	325	310	-

be even lower. A small amount of fracturing of the mudstone was observed in one boring located east of the ore body area, but in general fracturing or evidence of faulting was not observed in logs of cores from the ore body area. Thus, although local enhancement of porosity would occur during solution mining activities, migration of fluids far beyond the points of fluid injection is not expected to occur due to the very low permeability of the ore body and the enclosing mudstone formation.

The degree of hydraulic continuity between the central project area and the eastern project area, across Fault B, is not known, and groundwater data from the eastern project area is limited to a groundwater elevation from one well. As described in Section 3.2.2.5, while a groundwater elevation recorded in one well east of Fault B is similar to groundwater elevations from the central project area, the depth to groundwater from the surface appears to be somewhat deeper east of the fault, suggesting a lack of hydraulic continuity across the fault. This is consistent with the demonstrated effectiveness of the Pisgah fault and other faults in the region as groundwater barriers, particularly where clayey sediments are present to form relatively impermeable fault gouge within fault zones.

3.2.2.8 GROUNDWATER USE

Groundwater information reviewed for this report did not indicate domestic or drinking water use for wells in the project area or vicinity. Water quality information reviewed suggests that most or all of the groundwater in the area is unusable for human consumption or agriculture, based on elevated TDS and boron concentrations. Groundwater use information was provided by the DWR for several wells in the project area and vicinity. In the central project area, well 8N/5E-36D1 was listed as intended for industrial use. In the southern portion of western project area, two wells (8N/5E-34X1 and 8N/5E-34Z1) are listed as intended for industrial/manufacturing use and public/municipal use, respectively. A well located in the eastern project area, 8N/6E-20B1, located near the northeast corner of the project area, is listed as intended for agricultural use.

Significant present or planned groundwater use in the project area and vicinity is limited to consumptive use by FCMC and the Rheox, Inc. mining facility, located in the south-central project area. Planned consumptive groundwater use by the Rheox, Inc. facility would be approximately 14.6 acre-feet of groundwater per year. Consumptive groundwater use by the proposed action would be approximately 161 acre-feet annually.

3.3 CLIMATE AND AIR QUALITY

3.3.1 REGIONAL METEOROLOGICAL CONDITIONS

The project area is located in the Mojave Valley of the Mojave Desert in the southeast portion of California. The regional climate of this area is typically hot and dry in summer with cool, dry winters. These conditions result from the influence of the migrating semi-permanent pacific high pressure cell which lies in the eastern portion of the Pacific Ocean. During summer months the pacific high pressure cell increases in intensity due to the heating of the land and begins migrating northward. This deflects any incoming storms from the Pacific Ocean to the north. During winter months as temperatures decrease, the high moves southward allowing pacific northwest storms to occasionally permeate the southeast desert region. The typical coastal maritime weather of California rarely affects areas east of the coastal mountain range. Occasionally in the summer months warm, moist tropical air masses move northward from the gulf regions of Mexico and California producing light scattered showers throughout the central desert and mountains.

3.3.1.1 WIND

The predominant factor influencing atmospheric air movement in the Mojave Desert region is the prevailing westerly winds created by the pacific high pressure cell. Northwesterly winds are pronounced in the summer months due to the diurnal temperature fluctuations of the land, enhancing the effects of the high pressure cell. During winter months westerly winds dominate, usually at lower mean average speeds than summer.

Local meteorological conditions are mainly influenced by the surrounding topography. The project area in the Mojave Valley is located between two mountain ranges, the Cady Mountains to the north and the Lava Bed Mountains to the south. The valley floor is at an elevation of 2,100 feet while the elevations of surrounding mountains range up to 4,400 feet. This type of topographical situation is indicative of high winds through the valley generated by the compaction of an air mass between the mountain ranges.

Daggett Airport, located approximately 28 miles to the west, recorded wind direction and wind speed from the years 1955 to 1964 (Table 3.3-1). The mean average wind speed during this observation period was recorded at 9.8 knots [11.3 miles per hour (mph)]. The highest mean wind speed is recorded at 15.1 knots (17.4 mph). The lowest mean wind speed was recorded at 6.7 knots (7.7 mph). Wind direction occurs from the west-northwest the majority of the time.

TABLE 3.3-1

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED
(From Hourly Observations)
Daggett, California
1955-1964

Wind Sector	Wind Speed Class (knots)							Mean Wind Speed (knots)
	1-3	4-6	7-10	11-16	17-21	21	%	
N	0.1	0.6	0.5	0.2	0.0	0.0	1.4	7.5
NNE	0.1	0.4	0.4	0.2	0.1	0.0	1.2	8.5
NE	0.1	1.0	1.0	0.2	0.0		2.4	7.4
ENE	0.1	0.7	0.9	0.3	0.0	0.0	1.9	7.7
E	0.1	1.3	1.6	0.6	0.1	0.0	3.7	8.0
ESE	0.1	0.7	0.7	0.3	0.1	0.0	1.9	8.1
SE	0.1	0.8	0.4	0.1	0.0	0.0	1.4	6.7
SSE	0.0	0.3	0.1	0.0	0.0	0.0	0.5	6.8
S	0.0	0.3	0.1	0.0	0.0	0.0	0.6	6.9
SSW	0.0	0.2	0.1	0.1	0.1	0.0	0.5	9.9
SW	0.1	0.5	0.6	0.8	1.0	0.4	3.3	14.1
WSW	0.1	0.9	2.1	3.4	3.8	1.3	11.6	15.1
W	0.1	2.7	8.7	6.3	3.3	1.4	22.5	12.1
WNW	0.1	3.2	11.0	8.1	2.0	0.5	24.9	10.8
NW	0.1	1.9	4.2	2.2	0.2	0.0	8.6	9.2
NNW	0.1	0.6	0.7	0.3	0.0	0.0	1.7	8.0
CALM							11.8	
TOTAL	1.3	16.0	33.4	23.0	10.8	3.7	100.0	9.8

Source: Wind in California, Bulletin No. 185.

Edwards Air Force Base (Edwards) is located approximately 42 miles west of Daggett Airport and has also recorded wind data for the years 1968 to 1970 (Table 3.3-2). Edwards is mainly on a dry lake bed featuring miles of flat lands, and experiences lower wind speeds relative to the project area. The mean average wind speed at Edwards was 3.92 meters per second (mps), or 8.77 mph. Wind direction occurs most frequently from the west-southwest. The highest mean average wind speed was recorded at 5.13 mps (11.48 mph) from the west-southwest.

3.3.1.2 PRECIPITATION

Precipitation data for the project area are most closely represented by Daggett Airport, Barstow, and Victorville meteorological stations. Barstow is located approximately 35 miles east of the project site, while Victorville lies approximately 53 miles to the southwest. Precipitation varies with altitude and is influenced by the local mountain ranges. In general, annual precipitation on the valley floor ranges from 3.6 inches (Daggett) to 5.4 inches (Victorville) per year. The representative precipitation data can be found in Table 3.3-3. Precipitation is highly variable from year to year and is dependent on the pacific high pressure cell. Occasional violent thunderstorms cause much localized runoff, filling local washes and washing out local roads. More subdued thunderstorms are more frequent.

3.3.1.3 TEMPERATURE AND HUMIDITY

Meteorological stations at Barstow, Daggett, and Victorville were used to characterize the monthly average temperatures of the project area. These monthly average temperatures for the various stations are presented in Table 3.3-4. From the data, it is evident that the warmest temperatures are experienced in July and the coolest in January.

Diurnal temperature ranges (defined as the difference between the daily maximum and minimum temperature) are large, up to 30°F to 40°F, due to the efficient heating and cooling of the land surface under generally clear skies. Temperatures frequently exceed 100°F during summer and occasionally dip below 32°F during winter.

The highest relative humidities are recorded during winter nights due to the low temperatures, whereas the driest conditions (due to excessively hot temperatures) occur during spring and summer afternoons.

TABLE 3.3-2

WIND FREQUENCY DISTRIBUTION
(Frequency in Percent of Total Observations)

Edwards Air Force Base
1968-1970

Wind Sector	Wind Speed Class (mps)									Mean Speed
	.76 to 2.00	**2.01 to 3.00**	**3.01 to 4.00**	**4.01 to 5.00**	**5.01 to 7.00**	**7.01 to 10.00**	**10.1 to 15.00**	**Greater than 15.00**	**Total**	
NNE	2.30	1.13	.70	.24	.16	.09	.03	0.00	4.65	2.22
NE	1.95	.67	.36	.21	.26	.14	.06	0.00	3.65	2.46
ENE	1.40	.51	.41	.24	.48	.21	.05	0.00	3.29	2.98
E	1.14	.42	.28	.14	.35	.18	.02	0.00	2.54	2.93
ESE	.86	.24	.18	.07	.06	.03	.00	0.00	1.44	2.09
SE	.75	.18	.09	.04	.05	.02	.02	0.00	1.14	1.97
SSE	.71	.26	.10	.04	.02	.02	.00	0.00	1.16	1.88
S	1.22	.51	.34	.10	.05	.02	.00	0.00	2.24	2.01
SSW	1.93	1.29	1.40	.87	.53	.16	.05	0.00	6.23	2.91
SW	3.06	2.66	3.14	2.69	3.07	2.08	.71	0.00	17.40	4.24
WSW	3.06	1.94	2.35	2.55	5.34	4.71	1.08	0.00	21.03	5.13
W	3.27	1.28	1.07	1.35	3.03	2.81	.71	.01	13.54	4.76
WNW	3.36	1.41	.49	.43	1.29	1.75	1.19	.05	9.95	4.65
NW	3.09	.98	.32	.25	.52	.85	.50	.01	6.52	3.61
NNW	2.03	.36	.17	.06	.08	.07	.01	0.00	2.79	1.77
N	1.64	.43	.21	.06	.05	.02	.00	0.00	2.41	1.71
CALM (5.75 mps)								0.00		
TOTAL	**31.76**	**14.26**	**11.61**	**9.356**	**15.34**	**13.15**	**4.45**	**0.08**	**100.00**	**3.92**

Source: National Weather Service, summary of hourly surface data.

TABLE 3.3-3

PRECIPITATION

Location	No. of Years Recorded	Average Precipitation (inches)												
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Barstow	48	0.80	0.54	0.64	0.19	0.08	0.09	0.26	0.23	0.20	0.34	0.32	0.58	4.27
Daggett	17	0.60	0.33	0.30	0.21	0.03	NA	0.31	0.50	0.33	0.19	0.32	0.48	3.60
Victorville	22	1.17	0.86	0.85	0.42	0.06	NA	0.06	0.13	0.12	0.29	0.52	0.93	5.41

NA = Data not available.

Source: Climatography of the United States, No. 86-4.
Local Climatological Data - Las Vegas, Nevada.

TABLE 3.3-4

MEAN TEMPERATURE FOR SELECTED LOCATIONS

Location	No. of Years Recorded	Mean Temperature (degrees F)												
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Average
Barstow	36	45.9	50.1	55.7	62.4	68.9	78.0	84.4	82.6	75.6	64.7	53.6	46.3	64
Daggett	17	46.8	51.4	56.5	56.2	72.1	80.4	87.2	85.0	80.1	68.1	55.0	48.2	66
Victorville	21	42.4	45.6	50.4	57.8	64.0	71.5	78.6	77.4	71.7	60.9	49.2	43.9	59

Source: Climatic Summary of the United States, California.
Climatography of the United States, No. 86-4.
Local Climatological Data - Las Vegas, Nevada.

3.3.1.4 INVERSIONS

Temperature inversions limit convective air circulation and hold pollutants near ground level at relatively high concentrations. An inversion typically occurs due to topographical features. When the air coming over a mountain tends to be warmer than the existing lower levels of air, an inversion layer is formed inhibiting any type of convective air movement. Temperature inversions are common in the desert regions often occurring between 6,000 and 8,000 feet in altitude during the summer months. Temperature inversions occur most often during early morning hours and at night. Inversions break down easily in summer due to the influx of convective heat during the daylight hours. In winter, temperature inversion bases are between 200 and 2,000 feet and last much longer due to the lack of intense convective heat.

3.3.2 AIR QUALITY STANDARDS

The effects of ambient air quality within an area depend on the characteristics of the receptors (population, crop, etc.) and the type, amount, and duration of exposure. Air quality standards specify upper limits of concentrations and durations of pollutants in the ambient air consistent with the management goal of preventing specific harmful effects. Air quality standards and background air quality information pertinent to the project area are described below.

The U.S. Environmental Protection Agency (EPA) and the California Air Resources Board (ARB), have established ambient air quality standards. National ambient air quality standards (NAAQS) specify acceptable pollutant concentrations which may be equaled and, in the case of short-term standards, exceeded up to once per year. California ambient air quality standards (CAAQS) specify unacceptable pollutant concentrations which should never be equaled or exceeded. Table 3.3-5 summarizes the current Federal and State standards.

3.3.2.1 ATTAINMENT/NONATTAINMENT STATUS

San Bernardino County, part of the Southeast Desert Air Basin (from the California/Nevada border parallel or nearly parallel to Interstate 15, southwest to and including Victorville and the surrounding area), is classified by EPA as "nonattainment" for ozone and particulate matter. All other major pollutants, sulfur dioxide (SO_2), oxides of nitrogen (NO_x), and carbon monoxide (CO) are considered "unclassified or better than national standards". It is generally believed that violations of the oxidant and particulate standards result from the transport of pollutants into the area from the South Coast Air Basin to the southwest, as well as wind-blown fugitive dust (40

TABLE 3.3-5

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Period	California^{a,b} Standards	National Standards^{c}	
			Primary^{b,d}	Secondary^{b,e}
NO_2	1-hour	0.25 ppm (470 μg/m^3)	--	--
	Annual	--	0.05 ppm (100 μg/m$^{3)}$	0.05 ppm (100 μg/m^3)
SO_2	1-hour	0.25 ppm (655 μg/m^3)	--	--
	3-hour	--	--	1300 μg/m^3
	24-hour	0.05 ppm$_f$ (131 μg/m^3)	0.14 ppm (365 μg/m$^{3)}$	--
	Annual	--	0.03 ppm (80 μg/m$^{3)}$	--
CO	1-hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m$^{3)}$	--
	8-hour	9.0 ppm (10 mg/m^3)	9.0 ppm (10 mg/m^3)	--
O_3	1-hour	0.09 ppm (180 μg/m^3)	0.12 ppm (240 μg/m^3	0.12 ppm 240 μg/m^3
PM_{10}	24-hour	50 μg/m^3	150 μg/m^3	150 μg/m^3
	Annual	30 μg/m^3	50 μg/m^3	50 μg/m^3
Sulfates	24-hour	25 μg/m^3	--	--
Lead	30-day	1.5 μg/m^3	--	--

Notes on Ambient Air Quality Standards:

a. California standards for ozone, carbon monoxide, sulfur dioxide (1 hour), nitrogen dioxide and particulate matter - PM_{10}, are values that are not to be exceeded. The sulfates, lead, hydrogen sulfide, vinyl chloride, and visibility reducing particles standards are not to be equaled or exceeded.

b. Concentration is expressed first in units in which it was promulgated. Equivalent units given in parenthesis are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of mercury (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

c. National standards, other than ozone and those based on annual averages or annual arithmetic means, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.

d. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency.

e. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the implementation plan is approved by the EPA.

f. At locations where the state standards for ozone and/or suspended particulate matter are violated. National standards apply elsewhere.

CFR 81). Due to recent exceedances of the NAAQS, particulate matter less than ten microns in diameter (PM_{10}) are being considered for redesignation in the Victorville area as nonattainment. Ozone (O_3) is classified as nonattainment by the EPA for all areas of the Southeast Desert Air Basin (SEDAB).

3.3.3 EXISTING AIR QUALITY

The project area is located within the SEDAB of California. The available California air quality data (California ARB, annual summary) supplied information for Victorville, Twenty-Nine Palms and Barstow. These are the closest monitoring station locations to the project area. The air contaminants of concern in characterizing the existing air quality in the project area are O_3, CO, NO_x measured as nitrogen dioxide (NO_2), SO_2, and PM_{10}. These are known as the criteria pollutants. A three-year period (from 1988 to 1990) of criteria pollutant data for the monitoring stations is presented in Table 3.3-6.

3.3.3.1 OZONE/OXIDANTS

Ozone is formed in the atmosphere through a series of complex chemical reactions, primarily involving reactive organic gases (ROGs) and NO_x in the presence of sunlight. Ozone is the principal oxidant compound in the California atmosphere (ARB, 1976). For this reason, and the fact that measured oxidant concentrations are often reported as O_3, oxidant and O_3 are often considered synonymous.

Maximum hourly O_3 concentrations generally occur during afternoon hours between April and September. Concentrations are generally higher in rural areas than in adjacent urban areas, probably because of the scavenging effect of urban nitric oxide emissions on ozone concentrations.

Maximum one-hour concentrations measured during 1988-1990 in the project vicinity are shown in Table 3.3-6. Highest concentration levels for all three years at Barstow, Twenty-Nine Palms and Victorville exhibit an exceedance of both NAAQS (0.12 ppm) and CAAQS (0.09 ppm) ozone levels.

TABLE 3.3-6

HIGHEST POLLUTANT CONCENTRATION LEVELS ANNUAL STATISTICS

	Ozone (ppm)	CO (ppm)		NO_2 (ppm)	SO_2 (ppm)		PM_{10} (ug/m^3)	
	1 HR	1 HR	8 HR	1 HR	1 HR	24 HR	High	Geo Mean
Barstow								
1988	0.15	13.0	3.8	0.09	--	--	47	26.6
1989	0.14	7.0	3.9	0.10	--	--	191	38.4
1990	0.13	5.0	3.9	0.14	--	--	381	39.0
Twenty Nine Palms								
1988	0.15	--	--	--	--	--	--	--
1989	0.13	--	--	--	--	--	155	39.9
1990	0.14	--	--	--	--	--	297	26.3
Victorville								
1988	0.18	--	--	--	0.04	0.01	51	35.5
1989	0.17	--	--	--	0.06	0.03	--	--
1990	0.18	--	--	0.07	0.05	0.03	105	53.4

3.3.3.2 PARTICULATE MATTER

Wind blown fugitive dust is a major source of ambient particulate concentrations in the project area. PM_{10} is included as a criteria pollutant due to its ability to be lodged deep in the lung tissue. The body's defense mechanism is only capable of dislodging particles greater than 10 microns. Victorville exceeded the annual geometric mean CAAQS (50 $\mu g/m^3$) in 1990.

3.3.3.3 CARBON MONOXIDE

Carbon monoxide in non-urban areas is produced by forest fires and agricultural burning. One-hour and eight-hour standards are set due to the short-term deleterious effects of high concentrations of CO in the bloodstream. CO concentrations were below both State and Federal standards as measured at the monitoring stations.

3.3.3.4 NITROGEN OXIDES

Nitrogen oxides (NO_x) describe composite atmospheric concentrations of nitrogen oxide (NO) and nitrogen dioxide (NO_2). NO_2 emissions are considered to be a precursor to ozone formation. NO concentrations typically peak in the early morning hours associated with emissions from morning traffic. It then reacts with reactive hydrocarbons (another chemical compound considered to be a precursor to ozone) and decreases as NO_2 begins peaking and remains high until reactions of NO_2 take place in the formation of O_3 through photochemical processes. The Barstow and Victorville monitoring stations demonstrate NO_2 concentrations falling well within the Federal and State standards as presented in Table 3.3-6.

3.3.3.5 SULFUR DIOXIDE

Sulfur dioxide (SO_2) is a non-flammable colorless gas with a pungent irritating odor. Although plants and animals require sulfur, large concentrations can cause severe damage. SO_2 is monitored over 24-hour, 3-hour and 1-hour periods, as well as annually. SO_2 was not recorded at the Barstow or Twenty-Nine Palms stations, but is accounted for at the Victorville station. These data show no exceedances of the Federal or State ambient air quality standards.

3.3.4 COMPLIANCE STATUS

The San Bernardino County Air Pollution Control District (SBCAPCD) has jurisdiction over the proposed action. In addition to Federal and State ambient air quality standards, local rules and regulations would also apply. The following SBCAPCD rules and regulations may be applicable to the proposed action:

• Standards for Permits to Construct	Rule 213
• Fugitive Dust	Rule 403
• Particulate Matter	Rule 404
• Use of Solvents	Rule 442
• Pumps and Compressors	Rule 466
• New Source Performance Standards	Rule 902
• New Source Review	Rule 1300

With the recent amendments made to the California Clean Air Act (CCAA), the SBCAPCD New Source Review (NSR) rule would undergo changes to meet these new requirements. However, currently the SBCAPCD NSR rule would require Net Emission Increases (NEI) not to exceed 250 lbs/day of any criteria pollutant.

3.4 NOISE

Noise is defined as "unwanted" sound, and is typically measured in decibels (Db). Decibels are measured on a logarithmic scale with zero being the threshold of human hearing. This means that a noise level 10 dB higher than another is twice as loud, 20 dB is four times louder, 30 dB is eight times louder, etc. The human ear subjectively judges the loudness of two sounds by the ratio of their intensities or pressure. For this reason, decibels have been A-weighted (dBA) to provide a scale with the range and characteristics most consistent with the human ear. Just as decibels are measured on a logarithmic scale, sound waves attenuate exponentially (the inverse of a logarithmic function). Measurements of 10 dBA are characteristic of a light wind or rain, 45 dBA interferes with sleep, and 50 to 60 dBA is typical of a normal conversation. Constant sound levels of 85 dBA or greater are capable of temporarily impairing hearing and 130 dBA or greater causes pain and permanent damage. Prolonged exposure or short intervals of continuous high decibel noises leads to adverse physiological effects in the human body. For example, reduced blood flow, dilation of the pupils, paling of the skin and tensing of voluntary and involuntary muscles are the immediate major adverse effects associated with high noise levels.

The background noise levels in and around the project area are dominated mainly by freeway traffic from I-40, and the operation of the Rheox, Inc., hectorite clay mine adjacent to the project site. Noise levels from I-40 and the railway are typically in the 70 dBA range in areas immediately adjacent to the thoroughfare. The open-pit hectorite clay mine is a major source of noise in the area. In addition, railway traffic (approximately 75 dBA) and low-altitude aircraft from air force test flights are intermittent sources of noise. Noise from these sources, particularly the test flights, would be substantial when they occur. There are no sensitive receptors (hospitals, schools, residences, etc.) within at least a few miles of the proposed site.

3.5 BIOLOGICAL RESOURCES

3.5.1 BIOLOGICAL SETTING

The project area lies within the Mojavian Floristic/Physiographic Region (Cronquist et al., 1972) which is characterized by moderate to high mountain ranges and intervening valleys arranged generally in a north-south parallel pattern. Topographic relief within the project area is relatively low, with low hills separated by washes in the northern and eastern portions of the project area and basalt flows covering the ground surface in the central and southern portions of the project area. The Mojave Desert is characterized by hot, dry summers and cool, dry winters. Precipitation occurs sporadically from either winter rains or summer thunderstorms.

3.5.1.1 BOTANICAL RESOURCES

The vegetation type in the project area is creosote bush scrub. This association is dominated by two shrubs, creosote bush *(Larrea tridentata),* and white bursage *(Ambrosia dumosa).* Other plants commonly seen include bladder sage *(Salazaria mexicana),* cheesebush *(Hymenoclea salsola),* beavertail cactus *(Opuntia basilaris),* Anderson thornbush *(Lycium andersonii),* and Mojave yucca *(Yucca schidigera).* Table 3.5-1 contains a complete list of plant species observed during the vegetation and spring annual field surveys completed August and September 1989, and May and June 1990 by Lilburn Corporation (Lilburn Corporation, 1989, 1990).

3.5.1.2 WILDLIFE RESOURCES

The fauna associated with creosote bush scrub are adapted to desert scrub habitat with little cover and xeric conditions. Fish and amphibians are rare due to the scarce nature of surface water. Reptilian fauna, in contrast, are much more common and diverse. Several species of snakes occur in the project area, including the sidewinder *(Crotalus cerastes),* coachwhip *(Masticophis* *flagellum),* gopher snake *(Pituophis melanaleucus),* and spotted leaf-nosed snake *(Phyllorhynchus decurtatus).* These are significant predators of the small mammals found in the area. Lizards expected on or near the project area include the side-blotched lizard *(Uta stansburiana),* western whiptail *(Cnemidophorus tigris),* zebra-tailed lizard *(Callisaurus draconoides),* desert iguana *(Dipsosaurus dorsalis),* desert horned lizard *(Phrynosoma platyrhinos),* common chuckwalla *(Sauromalus obesus),* and desert night lizard *(Xantusia vigilis).* The desert tortoise *(Xerobates* [formerly *Gopherus*] *agassizii),* discussed in detail below, is also a year-round resident of the area.

A wide variety of avian species may be found on or near the project area. Many breed in the area and are year-round residents, while others are seasonally abundant. Common birds of prey include the turkey vulture *(Cathartes aura),* red-tailed hawk *(Buteo jamaicensis),* and American kestrel *(Falco sparverius).* Other birds of prey which may occur include the peregrine falcon *(Falco peregrinus),* prairie falcon *(Falco mexicanus),* great-horned owl *(Bubo virginianus),* and western screech-owl *(Otus kennicottii).* Other avian species which are locally abundant include

TABLE 3.5-1

PLANT SPECIES OBSERVED ON DESERT TORTOISE SURVEYS[1]

FAMILY	SCIENTIFIC NAME[2]	COMMON NAME[2]
AGAVACEAE	*Yucca schidigera*	Mohave Yucca
AMARANTHACEAE	*Tidestromia oblongifolia*	Honey sweet
APOCYNACEAE	*Amsonia tomentosa*	Dogbane
ASTERACEAE	*Ambrosia dumosa*	White-bursage
	Baileya pleniradiata	Wooly desert marigold
	Bebbia juncea	Sweetbush
	Encelia frutescens	Desert bush sunflower
	Hymenoclea salsola	Cheesebush
	Malacothrix glabrata	Desert dandelion
	Pectis papposa	Chinch weed
BORAGINACEAE	*Coldenia plicata*	Plicate coldenia
CACTACEAE	*Echinocactus polycephalus*	Cottontop
	Opuntia basilaris	Beavertail cactus
	Opuntia echinocarpa	Staghorn cholla
	Opuntia ramosissima	Lead pencil cholla
CAPPARACEAE	*Cleomella obtusfolia*	Blunt-leaf stinkweed
	Isomeris arborea	Bladder pod
CHENOPODIACEAE	*Atriplex canescens*	Wingscale
	Atriplex hymenelytra	Desert holly
	Atriplex polycarpa	Allscale
	Ceratoides (=Eurotia) lanata	Winter fat
	Salsola iberica	Russian thistle
CUCURBITACEAE	*Cucurbita palmata*	Palmate-leaved gourd
EPHEDRACEAE	*Ephedra californica*	California joint fir
EUPHORBIACEAE	*Eremocarpus setigerus*	Dove weed
	Euphorbia micromeria	Sonoran sand-mat
	Euphorbia polycarpa	Small-seeded sand-mat
FABACEAE	*Acacia greggii*	Catclaw
	Cassia armata	Armed senna
	Dalea fremontii	Indigo-bush
	Dalea spinosa	Smoke tree
GERANIACEAE	*Erodium cicutarium*	Red-stem filaree
HYDROPHYLLACEAE	*Phacelia distans*	Common phacelia
KRAMERIACEAE	*Krameria parvifolia*	Ratany
LAMIACEAE	*Salazaria mexicana*	Bladder sage
MALVACEAE	*Sphaeralcea emoryi*	Emory's desert mallow
NYCTAGINACEAE	*Allionia incarnata*	Windmills
	Mirabilis bigelovii	Wishbone bush
ONAGRACEAE	*Oenothera deltoides*	Large desert evening primrose

	Oenothera primiveris	Yellow desert evening primrose
POACEAE	*Bouteloua aristidoides*	Needle grama
	Bouteloua barbata	Six-weeks grama
	Erioneuron pulchellum	Fluff grass
	Hilaria rigida	Galleta grass
	Schismus arabicus	Abu mashi
	Stipa speciosa	Desert needlegrass
POLYGONACEAE	*Chorizanthe rigida*	Spiny-herb
	Eriogonum deflexum	Skeleton weed
	Eriogonum inflatum	Desert trumpet
SOLANACEAE	*Lycium andersonii*	Anderson box-thorn
	Nicotiana trigonophylla	Desert tobacco
	Physalis crassifolia	Ground cherry
TAMARICACEAE	*Tamarix* sp.	Tamarisk
ZYGOPHYLLACEAE	*Larrea tridentata*	Creosote bush
	Tributus terestris	Puncture vine

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[1] Species observed during surveys of August-September, 1989; May-June, 1990; and November, 1991.

[2] Scientific and common names follow Munz (1974) and Jaeger (1969).

the horned lark *(Eremophila alpestris),* common raven *(Corvus corax),* loggerhead shrike *(Lanius ludovicianus),* common poorwill *(Phalaenoptilus nuttallii),* greater roadrunner *(Geococcys californianus),* cactus wren *(Campylorhynchus bruenneicapillus),* and black-tailed gnat catcher *(Polioptila melanura).* LeConte's thrasher *(Toxostoma lecontei),* a known resident on the site, is classified by the CDFG as a species of special concern.

Creosote bush scrub habitat supports numerous mammalian species. The coyote *(Canus latrans),* desert kit fox *(Vulpes macrotis arsipus),* and badger *(Taxidea taxus)* are the larger species found in the project area. Small herbivores include the desert woodrat *(Neotoma lepida),* desert kangaroo rat *(Dipodomys deserti),* white-tailed antelope squirrel *(Ammospermophilus leucurus),* deer mouse *(Peromyscus maniculatus),* desert cottontail *(Sylvilagus audubonii),* and black-tailed hare *(Lepus californicus).* These latter species constitute much of the diets of mammalian, avian, and reptilian predators in the area. Almost a dozen bats have the potential to occur in the project area, according to range maps and habitat usage. Of these there are two, the California leaf-nosed bat *(Macrotus californicus),* and the spotted bat *(Euderma maculatum),* which are Federal candidate species. A comprehensive list of all wildlife observed during field surveys of the project area is shown in Table 3.5-2.

3.5.1.3 RESEARCH NATURAL AREA / PROPOSED AREA OF CRITICAL ENVIRONMENTAL CONCERN

The Fort Cady project area lies partially within an area which was proposed in 1992 as an Area of Critical Environmental Concern (ACEC). Pending evaluation of the area as an ACEC, the area continues to have interim status as a Research Natural Area, as identified in the CDCA plan. The CDCA plan indicates the Research Natural Area extends from the Pisgah Crater through the project area to I-40. This area is characterized by lava flows with drifting sand, alternating with sandy valleys. This creates a unique environment where animals normally associated with rocky areas, such as chuckwalla and desert night lizard, and animals normally associated with sandy areas, such as fringe-toed lizards, and valley bottom species, such as western whiptails and sidewinders, are found together.

3.5.1.4 STREAMBED CROSSINGS

Streambed crossings may require a 1603 Streambed Alteration Agreement from the California Department of Fish and Game (CDFG). This regulation is generally applied to blue lines and other fluvial systems with the bed and banks noted on USGS quadrangle maps, even if the waterway is an ephemeral stream. Twelve such blue lines exist within the project area. If aquatic or wetland wildlife values are affected by a proposed action, CDFG may require mitigation.

TABLE 3.5-2

WILDLIFE SPECIES OBSERVED DURING DESERT TORTOISE SURVEYS[1]

Common Name[2]	Scientific Name[2]
REPTILES	
Desert tortoise	*Xerobates [=Gopherus] agassizii*
Sidewinder	*Crotalus cerastes*
Spotted leaf-nosed snake	*Phyllorhynchus decurtatus*
Common chuckwalla	*Sauromalus obesus*
Desert iguana	*Dipsosaurus dorsalis*
Side-blotched lizard	*Uta stansburiana*
Western whiptail	*Cnemidophorus tigris*
Zebra-tailed lizard	*Callisaurus draconoides*
BIRDS	
Common Raven	*Corvus corax*
Greater Roadrunner	*Geococcyx californianus*
Horned Lark	*Eremophila alpestris*
LeConte's Thrasher	*Taxostoma lecontei*
Mourning Dove	*Zenaida macroura*
Prairie Falcon	*Falco mexicanus*
Verdin	*Auriparus flaviceps*
Western Kingbird	*Tyrannus verticalis*
MAMMALS	
Badger	*Taxidea taxus*
Black-tailed hare	*Lepus californicus*
Coyote	*Canis latrans*
Desert cottontail	*Sylvilagus audubonii*
Desert kangaroo rat	*Dipodomys deserti*
Desert kit fox	*Vulpes macrotis arsipus*
Desert woodrat	*Neotoma lepida*
White-tailed antelope squirrel	*Ammospermophilus leucurus*

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[1] Species directly observed or detected by sign (characteristic burrows, scats, or tracks) during surveys of August-September, 1989; May-June, 1990; and November 1991.

[2] Scientific and common names follow Collins, et al. (1982) and Stebbins (1985) for reptiles, American Ornithologists' Union (1983) for birds, and Jones et al. (1982) for mammals.

3.5.2 SUMMARY OF SENSITIVE RESOURCES

3.5.2.1 SENSITIVE PLANTS

Sensitive plant species in California consist of legally protected species, Federal candidates for listing, and species of special concern. See Table 3.5-3 for a description of such species occurring within the project vicinity. Legally protected species include those Federally-listed as threatened or endangered by U.S. Fish and Wildlife Service (USFWS, 1990a) and/or State-listed as critically endangered (CDFG, 1990a). Federal candidate species include taxa which are currently under consideration for Federal listing as threatened or endangered and include three categories. Category 1 candidates are taxa for which enough data are on file to support Federal listing, while Category 2 candidates are taxa for which threat and/or distribution data are insufficient to support Federal listing. Category 3C species are those formerly designated as Category 1 or 2, but subsequently found to be more abundant than previously believed (USFWS, 1990a). Federal Category 1 and 2 candidates, as well as species specially identified by the BLM State Director, are considered BLM-designated sensitive plant species.

Species of special concern are those taxa in any of several categories of sensitivity recognized by the California Native Plant Society (CNPS) (Smith and Berg, 1988). The categories include (in decreasing order of rarity and vulnerability): 1A) plants presumed extinct in California; 1B) plants rare, threatened or endangered in California and elsewhere; 2) plants rare, threatened or endangered in California but more common elsewhere; 3) plants about which more information is needed; and 4) plants of limited distribution.

No Federal or State-listed species are known or expected to occur in the area. One Federal candidate category 3C species, Parish's phacelia *(Phacelia parishii),* was last recorded northwest and southwest of the project area in 1941. It is a spring annual known from alkaline creosote bush scrub habitats, and is listed by the CNPS (Smith and Berg, 1988) as a List 1A species. (Although currently listed as 1A, a large population was found in Spring, 1991, southeast of Coyote Dry Lake near Ft. Irwin, California.)

Two species of special concern listed by the CNPS are known to occur in the project area and include the crucifixion thorn *(Castela emoryi),* a List 2 species, and the Utah cynanchum *(Cynanchum utahense),* a List 4 species. Both were found on the project site during a spring floral survey undertaken in 1990 (Lilburn, 1990).

TABLE 3.5-3
SENSITIVE SPECIES IN THE PROJECT AREA

Common Name[1]	Scientific Name[2]	Protection Status Fed/State/CNPS[3]	Habit[4]	Distribution and Ecological Notes[5]
1. Parish's Phacelia	Phacelia parishii	3C/ /1A	AH	Mojave Desert east of Victorville, to southern Nevada. Habitat: Alkaline sites Flowering period: April-June Vegetation type: CBS, JTW Elevation: 2000 - 6000 ft.
2. Crucifixion Thorn	Castela emoryi	/ /2	S	California Mojave, and Colorado Desert to Arizona Sonoran Desert. Habitat: Dry, gravelly areas Flowering period: June-July Vegetation type: CBS Elevation:
3. Utah Cynanchum	Cynanchum utahense	/ /4	S	Mojave Desert from California to Utah; Colorado Desert from California to Arizona. Habitat: Dry, sandy areas Flowering period: April-June Vegetation type: CBS Elevation: Below 3000 ft.
4. Cove's Cassia	Cassia coveii	/ /2	S	Colorado Desert, lower California, Arizona Habitat: Dry washes Flowering period: April-June Vegetation Type: CBS Elevation: Below 2000 ft.

TABLE 3.5-3 (Continued)

Common Name[1]	Scientific Name[2]	Protection Status Fed/State/CNPS[3]	Habit[4]	Distribution and Ecological Notes[5]
5. White-margined Beard Tongue	Penstemon albomarginatus	BLM/C2/1B	PH	Near Lavic, south Mojave Desert to southern Nevada; western Arizona. Habitat: Deep drifting sand Flowering period: March-May Vegetation type: CBS Elevation: ca. 1800 ft.

[1] Common names follow: Munz, 1974; Smith and Berg, 1988; Thorne et al., 1981.

[2] Scientific nomenclature follow: Munz, 1974; Smith and Berg, 1988.

[3] Protection Status

Federal:
C1 = Category 1 candidate for Federal listing; (USFWS, 1990a);
C2 = Category 2 candidate for Federal listing; (USFWS, 1990a);
C2* = Category 2 candidate which is presumed to be extinct; (USFWS, 1990a);
3C = Category 3 candidate for listing which is considered too common (USFWS, 1990a);
BLM = Species which the BLM considers as sensitive (includes Federal Category 1 and 2 candidates for listing, as well as species specially designated by the BLM's State Director).

CNPS (Smith and Berg, 1988);
Sensitivity categories listed in decreasing order of rarity:
1A = Presumed extinct in California
1B = Plants rare, threatened, or endangered in California and elsewhere
2 = Plants rare, threatened, or endangered in California, but more common elsewhere
3 = Plants about which more information is needed
4 = Plants of limited distribution

[4] Habit:
AH = annual herb;
PH = perennial herb;
S = shrub.

[5] Distribution and Ecological Notes: data gathered from Munz, 1974; Thorne, 1976; Smith and Berg, 1988.

TABLE 3.5-3 (Continued)
SENSITIVE SPECIES IN THE PROJECT AREA

Common Name[1]	Scientific Name[1]	Protection Status[2]	Regional Distribution[3]
6. Common Chuckwalla	*Sauromalus obesus*	C2/ /BLM	Year-round resident throughout the region. Utilizes lava flows and rocky hillsides.
7. Desert Tortoise	*Xerobates =[Gopherus] agassizii*	FT/ST/ /BLM	Year-round resident throughout the region in low desert habitat, as well as high desert habitat below 4,000 ft. Often associated with creosote bush scrub. Also utilizes hillsides, cut banks, washes, and other areas with natural crevices. Low to moderate densities in project area.
8. Peregrine Falcon	*Falco peregrinus*	FE/SE/ /P	Rare transient through the region. Utilizes hillsides and cliff-faces.
9. Prairie Falcon	*Falco mexicanus*	/ / /P	Year-round resident throughout the region. Forages over open habitats. Seen over project area in 1990.
10. LeConte's Thrasher	*Taxostoma lecontei*	/ /CSC/	Uncommon resident throughout the region. Utilizes open desert and sandy washes. Seen in project area in 1990.
11. Loggerhead Shrike	*Lanius ludovicianus*	C2/ / /BLM	Terrestrial year-round resident throughout the region. Forages from high perches in open, brushy habitat for insects, reptiles, birds, and small mammals.
12. Nelson's Bighorn Sheep	*Ovis canadensis nelsoni*	/ /G/BLM	Locally rare, year-round resident of the Cady Mountains. Utilize open, rocky, steep areas with available water and herbaceous forage. May move to lower elevations in winter.
13. Western Mastiff Bat	*Eumops perotis californicus*	/ /C2/BLM	Occurs primarily in the southwestern United States. Roosts in buildings, crevices and in tunnels. Little known about occurrence in the region, however, reported distribution includes the project area.
14. Spotted Bat	*Euderma maculatum*	/ /C2/BLM	Largest known concentrations near St. George, Utah; Big Bend region; and in Baja California. Roosts in buildings and caves. Little known about occurrence in the region, however reported distribution includes the project area.

TABLE 3.5-3 (Continued)

[1] Nomenclature follows Collins et al. (1982) for reptiles, American Ornithologists' Union (AOU) (1983) for birds and Jones et al. (1982) for mammals.

[2] Protection Status:

FE = Federal-listed endangered (USFWS, 1990b);
FT = Federal-listed threatened (USFWS, 1990b);
SE = State-listed endangered; (California department of Fish and Game [CDFG], 1990);
ST = State-listed threatened (CDFG, 1990);
C2 = Category 2 Federal candidate (sufficient data are on file for possible listing as threatened or endangered, but additional data are needed on vulnerability and threats; USFWS, 1990b);
3C = Category 3c Federal candidate (considered too common for listing) (USFWS, 1990b);
BLM = classified as a sensitive species by BLM (includes Federal Category 1 and 2 candidates for listing, as well as species specially designated by the BLM's State Director);
B = included on the National Audubon Society's Blue List of birds suffering significant decline in numbers throughout much of their ranges (Tate, 1986);
P = Included on the State of California's list of fully protected species (CDFG, 1991).
G = Included on the State of California's list of game species (State of California List of Game Species, CDFG, 1992).
CSC = National Diversity Database Special Animals (CDFG, 1990)

[3] Information on regional distribution from several sources, including:

1) personal communications;
2) 1991 database information from the CDFG Natural Diversity Data Base
3) previous environmental reports; and
4) various publications and unpublished reports and checklists.

In addition, two other species of special concern listed by the CNPS could potentially occur in the area. Coves' cassia *(Cassia covesii),* a CNPS List 2 species, is known from fifty miles east of the site. It is found in dry, gravelly washes. White-margined beard tongue *(Penstamen albomarginatus),* found in areas of drifting sand, is a CNPS List 1B species, a C2 candidate, and is BLM-designated as sensitive. It is known from approximately ten miles east of the site.

Creosote rings, a unique plant assemblage, have the possibility of occurring on the site. These are formed by the outward growth and expansion of a single creosote bush over time, dying out from the center as the bush grows to form rings or "clones" of the original bushes. The largest known creosote rings exceed 65 feet in diameter and have been estimated to be as much as 11,700 years old (Vasek, 1980), thus making them among the oldest living entities on earth. No creosote rings of any size were observed on the project site.

3.5.2.2 SENSITIVE WILDLIFE

Sensitive wildlife species in California consist of legally protected species, Federal candidates for listing, and/or BLM-designated as sensitive species, as well as state-designated species. Legally protected species include those Federally-listed as threatened or endangered (USFWS, 1990b) and/or State-listed as endangered or rare (CDFG, 1990a). Federal candidate species (USFWS, 1990b) include taxa which are currently under consideration for Federal listing as threatened or endangered. Category 2 Federal candidates are taxa for which data on rarity are sufficient for listing, but for which data on threats and/or distribution are insufficient. Other species of special concern include: 1) additional species designated by the BLM State Director; 2) California State game animals; and 3) birds declining on a nation-wide basis, and therefore, listed on the National Audubon Society's Blue List (Tate, 1986). All raptors are considered as protected species in California (CDFG, 1991).

Based on literature review and reconnaissance field surveys, nine sensitive wildlife species are known or have the potential to occur in the project area. Of those, two are Federally-listed species (the desert tortoise and peregrine falcon). The desert tortoise is also State-listed as threatened, and the peregrine falcon is State-listed as endangered. A separate Biological Assessment for the desert tortoise was submitted to USFWS as part of the Section 7 consultation required by the Endangered Species Act, as amended.

Seven additional sensitive species are known, or have the potential, to occur in the project area. One lizard, three birds, and three mammals are Federal candidates and/or State-protected species, including the prairie falcon, LeConte's thrasher, the Loggerhead shrike, Nelson's bighorn sheep, the California leaf-nosed bat, the spotted bat, and the common chuckwalla.

Among these species, the prairie falcon is a State-protected bird, but has no other sensitivity status. LeConte's thrasher is a CDFG Species of Special Concern, Priority 3 (CSC-3) species. This indicates that it is not currently in danger of extirpation; however, due to its small population in California, it is vulnerable to threats. The Loggerhead shrike is a C2 species whose range includes most of the United States and Mexico. Nelson's bighorn sheep, a locally rare game animal found in the Cady Mountains, ten miles to the north of the project site, has been designated sensitive by the BLM. The California leaf-nosed bat is a candidate (C2) for Federal protection. Caves, abandoned mines, and abandoned buildings are its usual roost-site during the day. Little is known about the distribution of the spotted bat, also a C2 species, in the region. It may occur on a rare to uncommon basis, particularly near riparian habitat. Its occurrence in the project area, therefore, is highly unlikely given the lack of riparian habitat. Both the California leaf-nosed bat and the spotted bat are designated as sensitive by the BLM. The prairie falcon and LeConte's thrasher were both seen during field surveys (Lilburn, 1990; Dames & Moore, 1991).

3.5.2.3 DESERT TORTOISE

Biological surveys in the project area indicate that the primary wildlife resource concerns are those associated with the declining Mojave desert tortoise population. The decline is probably due to a number of reasons, including a disease condition exacerbated by the stress of several drought seasons, loss of habitat, predation by ravens, and direct disturbance by humans. In response to these declines, the USFWS listed the Mojave population of the desert tortoise as a threatened species (USFWS, 1990c).

Desert tortoise occurrence and mitigation in the project area are addressed in a Biological Assessment (Dames & Moore, 1991) and Biological Opinions (USFWS, 1992 and 1993). Information was developed from previous BLM data, previous survey sources, literature sources, and intensive walk-over and triangular strip surveys conducted on the project area in August and September, 1989; May and June, 1990; and early November, 1991.

Three hundred forty-one acres of the project area are considered to be suitable desert tortoise habitat, while overall tortoise density in the project area was estimated to be low (a range of 10-45 tortoises per square mile) (Dames & Moore, 1991); there was some variation in densities, including one area of very high density (see Biological Assessment for more detail). See Figure 3.5-1 for the location of transects and triangles surveyed for evidence of desert tortoises within the project area.

3.6 LAND USE / RECREATION

3.6.1 EXISTING USES

Regional land uses include typical activities found in other areas of the Mojave Desert, such as mining, dispersed desert recreation, military bases (including airfields, bombing ranges and gunnery ranges), transportation networks (including railroads and highways), and large-scale electric transmission lines and gas pipelines. Mining for hectorite presently occurs at the Hector Mine located southwest of the proposed site. In addition, aggregate lava rock has been mined near the Pisgah Crater east of the project area. The Twenty-Nine Palms Marine Corps Base is located just south of the project area boundary; at the present time, the Base area has not been developed and appears to be held as reserved, restricted open space.

In-situ boric acid test mining was conducted on the project site in 1981-82, and again in 1987-88. The pilot facilities consist of several metal buildings, trailers, tanks and other equipment, small evaporation ponds, and overhead electric distribution lines. There is no residential or commercial development in the vicinity of the project, and due to a lack of infrastructure, groundwater, and distance from other developed areas, no development is expected in the foreseeable future.

Although no established recreation areas or facilities are located on or near the project area, dispersed off-road recreation does occur where access is obtainable from the National Trails Highway or other local area roads. The Pisgah Crater lava flow, which covers portions of the project area, has historically been used for scientific research. The lava flow was designated as a Research Natural Area in the California Desert Conservation Area (CDCA) Plan, but no specific recreation or land use management policies presently exist for this designation. The Research Natural Area status is interim, and will expire when the evaluation of the ACEC designation for the area, proposed in 1992, is complete. There are no wilderness study areas associated with the pending 1992 Congressional legislation in close proximity to the site (the nearest areas, the

Rodman Mountains and Newberry Mountains, are approximately twenty miles to the west and southwest). At the present time, no other uses other than those listed above are evident within the project area; the remainder of the area appears to be desert open space.

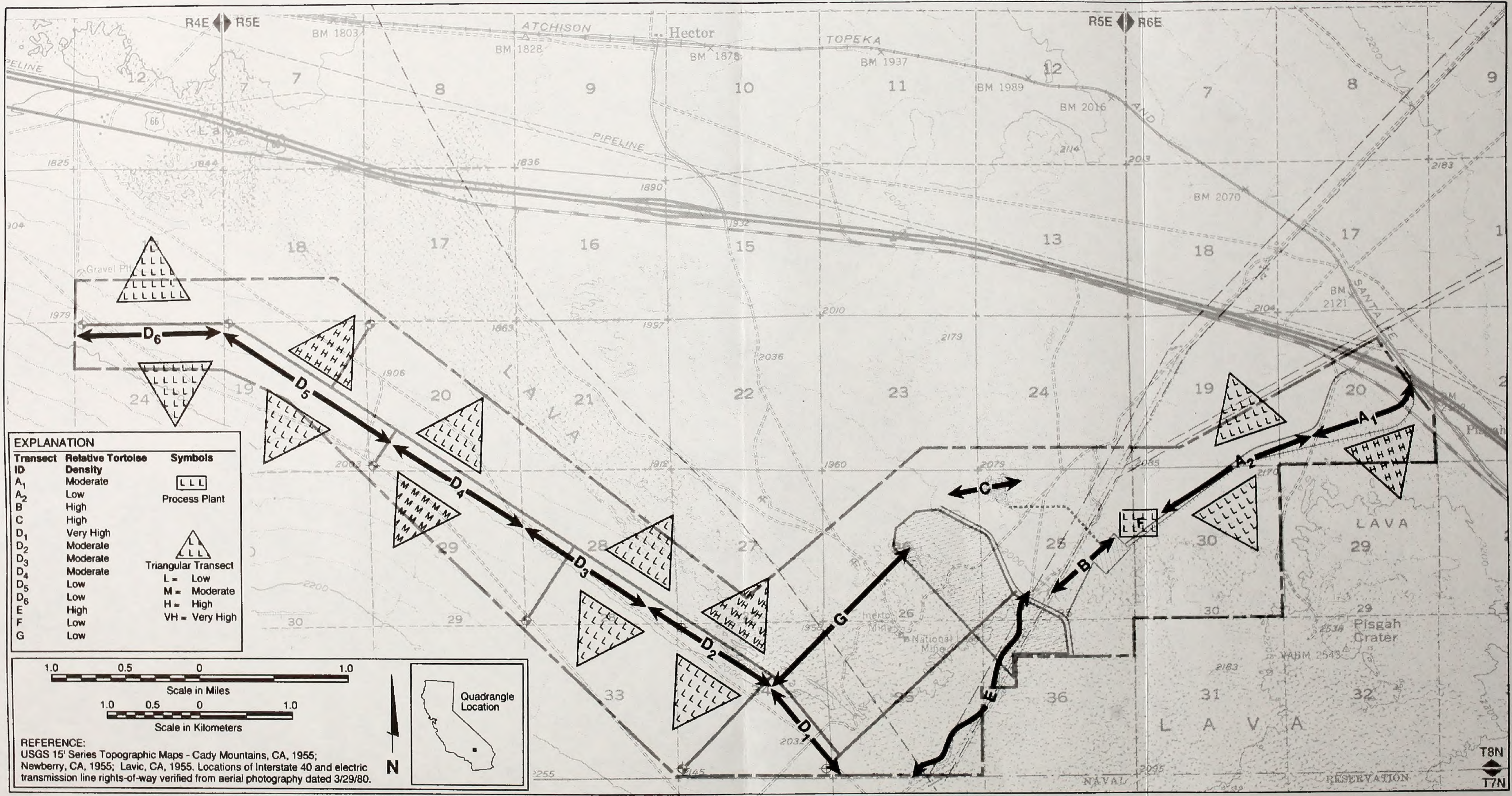
Several high-voltage transmission lines cross the project area from southwest to northeast; the right-of-way widths vary from approximately 100 to 500 feet. Two Southern California Gas Company underground pipelines, line 235 with a 34-inch diameter and the 30-inch diameter line 3000, are located just north of the project area. Numerous existing trails and roads crisscross the project area. The Atchison, Topeka, and Santa Fe Railroad lies two miles north of the project site.

3.6.2 EXISTING POLICIES/GUIDELINES

Within the vicinity of the Fort Cady project, land use policies and project permitting are determined at Federal, State and local levels. Jurisdictions include the BLM, the State of California, and San Bernardino County. A significant portion of the project area is located on land managed by the BLM. Land use on BLM land is directed by the CDCA Plan, which was finalized in 1980. The CDCA Plan was mandated by the Federal Land Policy and Management Act (1976), and was developed to establish guidelines for the multiple-use management of 12 million acres of public land within the CDCA. The San Bernardino County General Plan (completed in 1988, revised in 1990) identifies a variety of land use criteria and policies which are intended to direct sensitive uses and compatibilities.

3.6.2.1 CALIFORNIA DESERT CONSERVATION AREA PLAN

The CDCA Plan designates multiple-use classes for the entire CDCA planning area which reflect relative resource sensitivities and prescribed uses for specific geographic areas. Four classes have been developed, including Class C (proposed and future wilderness areas); Class L (limited use designated to protect resources and provide lower-intensity, carefully controlled resource use); Class M (moderate use, which balances higher-intensity use and protection); and Class I (intensive/concentrated uses required to meet human needs). The project area is located within Class M which allows the following uses per the directed class guidelines: mining, livestock grazing, recreation, energy, and utility development. Land use management in a Class M area is also designed to conserve desert resources and to mitigate damage to those resources which permitted uses may cause.



EXPLANATION

Transect ID	Relative Tortoise Density
A_1	Moderate
A_2	Low
B	High
C	High
D_1	Very High
D_2	Moderate
D_3	Moderate
D_4	Moderate
D_5	Low
D_6	Low
E	High
F	Low
G	Low

Symbols

L L L Process Plant

Triangular Transect
L = Low
M = Moderate
H = High
VH = Very High

1.0 0.5 0 1.0
Scale in Miles

1.0 0.5 0 1.0
Scale in Kilometers

REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

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AREAS SURVEYED FOR DESERT TORTOISE

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 3.5-1

In addition, several other CDCA designations potentially affect land use within the project area and in the vicinity of the project. A two-mile-wide energy production and utility corridor parallels I-40 north of the project area, but does not affect land uses within the project area. The CDCA also identifies two livestock grazing allotments in the general vicinity of the project. The Cady Mountain ephemeral/perennial allotment includes over 100 square miles north of the Santa Fe Railway and I-40; the Ord Mountain ephemeral/perennial allotment is located approximately 15 miles southwest of the project area near the Rodman Mountains. Neither allotment includes acreages within the project area.

The Pisgah lava flow, as discussed earlier, is classified as a Research Natural Area within the Special Areas Program contained in the CDCA. The program recognizes significant natural and cultural resources found in BLM-administered land, and provides for uses in the Special Areas which are otherwise permitted by law or Federal regulations, and that are consistent with the primary uses of the areas (research and education). Most of the project area is located within the Research Natural Area as defined by the CDCA Plan; the water wells lie south of the Area. The area presently contained within the Research Natural Area has also been proposed for classification as the Pisgah Crater Area of Critical Environmental Concern (ACEC). The creation of an ACEC to further recognize the unique wildlife habitat and botanic resources associated with the lava flow has been recommended by BLM Area Wildlife Biologists, the BLM's West Mojave Tortoise Plan Team, the U.S. Fish and Wildlife Service, and the California Native Plant Society.

3.6.2.2 THE SAN BERNARDINO COUNTY GENERAL PLAN

The San Bernardino County General Plan contains the following designations and policies/actions which pertain to the proposed action:

1. The project site is within the Baker Subregional Planning Area (RSA-31) of the Desert Region. A portion of the project site (all facilities in Range 5E, including the Process Plant) is also technically incorporated in the Newberry Springs/Harvard Community Planning area. At the present time, the County has not implemented any specific planning area policies or actions which pertain to the construction and operation of the project.

2. The project is located in the Resource Conservation Land Use District, which primarily incorporates:

- open space and non-agricultural activities;
- compatible agricultural and other uses (including mining, per Policy MR-3);
- areas with limited/no infrastructure and no plans for improvements in the next 20 years; and
- areas which are slated for management by another governmental agency and/or are included in a Hazard/Resource Overlay area.

3. The project area has been designated with a Planning Improvement Level of 5 (Desert Region), which is associated with areas of little or no development potential in remote or relatively inaccessible locations. Required improvements are limited to septic systems, easement grants, and legal/physical access.

4. Building intensity standards include a minimum parcel size of 40 gross acres, a minimum district size of 200 gross acres, and a maximum building height of 35 feet; these standards may be modified by provisions included in the County Development Code, Title 8.

5. The area includes two Hazard Overlay Areas: the Alquist-Priolo Geologic Special Study Zone (which requires delineation of identified geologic issues), and the AR-4 Airport Safety Overlay District (which coincides with low-altitude/high speed military aircraft corridors in the project vicinity, and typically limits building heights to 35 feet). Any proposed structures in Airport Safety Review Areas which exceed 35 feet in height are subject to a Land Use Compliance Review. The existing high-voltage transmission lines which cross the proposed action site are approximately 100 feet in height.

3.7 VISUAL RESOURCES

3.7.1 EXISTING VISUAL CHARACTER

3.7.1.1 REGIONAL CHARACTER

The regional landscape character reflects the landform and vegetation typical of the central Mojave Desert. Land uses in the region include dispersed recreation, mining, military bases (Twenty-Nine Palms Marine Corps Base is directly south of the project) and transportation/utility arteries.

Several mountain ranges dominate landscape views, including the Cady and Bristol Mountains north of I-40 and the Rodman, and Newberry Mountains south of I-40. Elevations range from over 4,000 feet above MSL in the mountainous areas to less than 1,000 in the dry lake bed (Troy Lake) west of the project area.

Other important landform and cover characteristics include numerous washes which define low points and drainage patterns; scattered desert vegetation (including creosote bush, yucca, desert almond, and catclaw acacia) which also reflect moisture and drainage patterns; and a variety of highly visible man-made transportation and energy-related features which criss-cross the landscape, including the I-40/Highway 66/Atchison, Topeka, and Santa Fe Railway right-of-way, transmission line rights-of-way, off-road vehicular access, and disturbances associated with several natural gas pipeline projects.

The Pisgah Crater and the lava flow associated with the extinct volcano represent the most unique landscape features in the vicinity of the project. The volcano, which rises to an elevation of 2,500 feet, and the high contrast between the dark lava and the light-colored desert soils are highly visible due to its proximity to the highway corridor.

The BLM management of scenic resources quality is subject to its Visual Resource Management (VRM) system. The system assigns management class ratings from Class I (highest rating) to Class V (lowest rating). The class ratings reflect combined assessments of viewer sensitivity, scenic quality, and the average distance from which an area is typically viewed. Each management class rating corresponds to an allowable level of landscape modification that may result from a proposed action. A Contrast Rating System is used to identify the amount of contrast, and hence impact, expected with project features or operations.

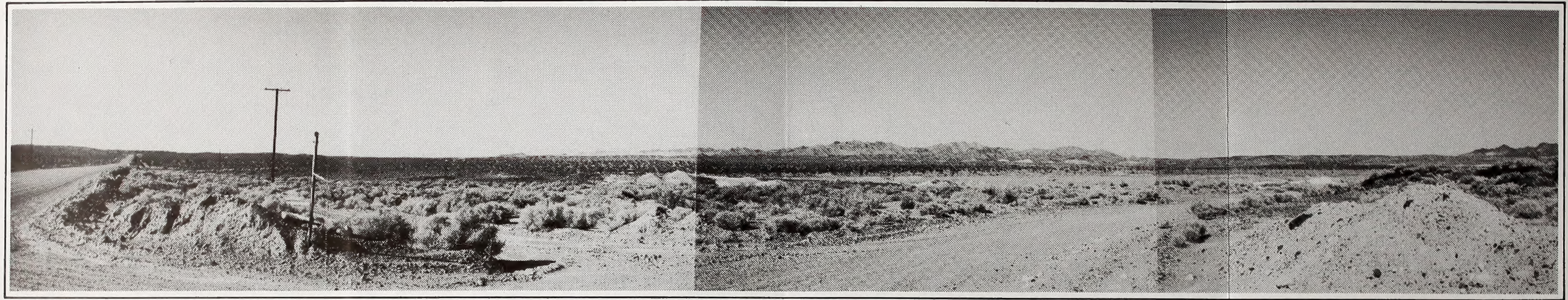
Regional classifications include Class II (the Pisgah Crater and lava flow, and the Sleeping Beauty area of the Cady Mountains north and east of the project site); Class III (the remainder of all areas within approximately three to five miles of the I-40 corridor); and Class IV (areas at distances typically greater than five miles from the Interstate corridor). The entire area is assessed a high viewer sensitivity, and scenic quality varies from level C (typical; common features) in most of the region to level B (some outstanding features mixed with common characteristics) in the Pisgah Crater/lava flow area and the south-facing slopes of the Cady Mountains.

3.7.1.2 PROJECT SITE CHARACTER

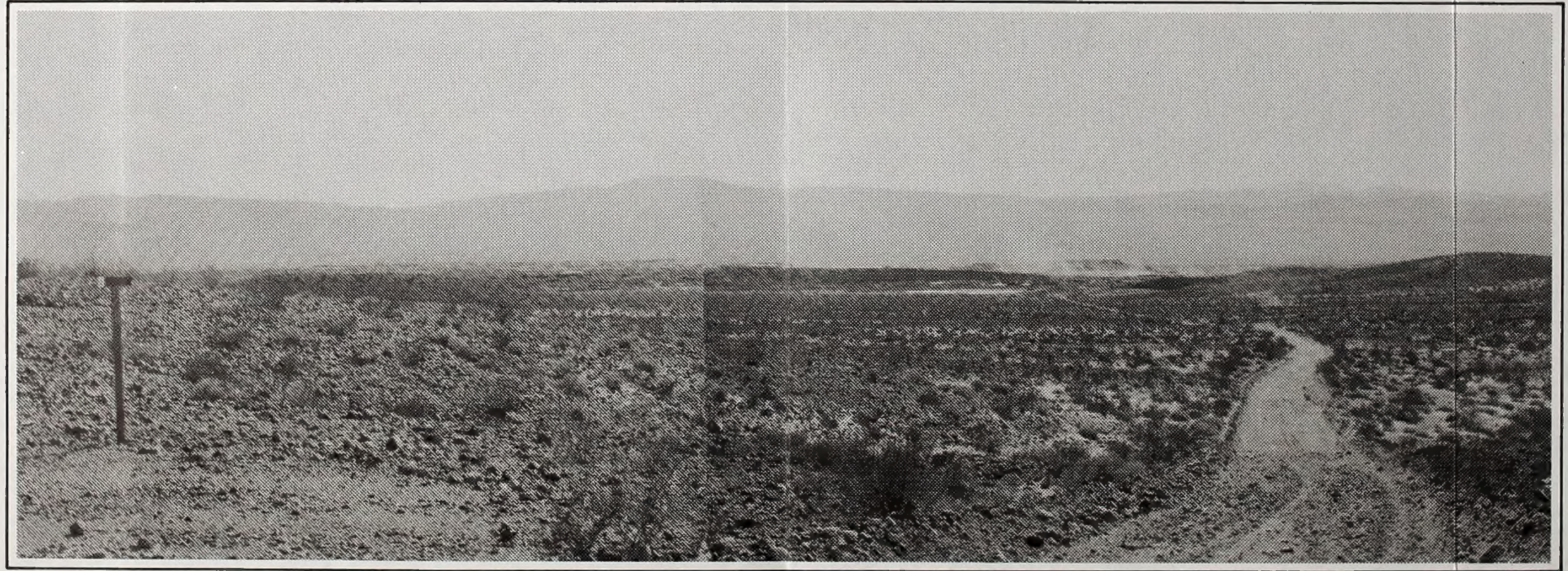
LANDSCAPE CHARACTER - The project is located on a relatively flat site . Slopes vary from 0 to 10 percent, and elevation increases approximately 100 feet from south to north within the proposed developed portions of the site. A dry wash is located just east of the proposed process plant site, and the crater lava flow covers a significant portion of the ore body and proposed well field. Exposed soil and rock vary in color from tan to nearly white; the lava flow varies from dark gray to black. Vegetation is typically sparse creosote bush scrub. Human modifications on or near the site include three steel-tower, high-voltage transmission lines which converge and pass near the proposed process plant; the existing pilot plant and associated equipment; the Hector Mine located south of the ore body; and numerous roads and off-road vehicle trails. Figure 3.7-1a, b, c, includes photographs from numerous viewpoints in the project vicinity; Figure 3.7-2 defines viewpoint locations. The existing character of each of the proposed alternative process plant site locations is similar to that described for the project site, with the exception of one less transmission line and less disturbance near the sites.

SCENIC QUALITY - Two levels of scenic quality have been defined within the project area through the BLM VRM Program. Level B (moderate scenic quality) includes all areas associated with the Pisgah Crater lava flow. The unusual color contrast, texture contrast, and unique crater landform are the principal scenic elements which combine to reflect the moderate quality. All of the remaining project area has been classified level C, which is assigned to landscapes which reflect common features in the region.

SITE VISIBILITY - Potential views of the proposed site and alternative process plant sites occur from the access roads to the Hector Mine and Pisgah Crater; from Highway 66 (National Trails Highway) and I-40, and from two daily Amtrak passenger trains. Annualized Average Daily Traffic for I-40 and Highway 66 combined is approximately 10,700 (Meza, 1991, San Bernardino County, 1991: see references for Transportation). The Amtrak trains are presently scheduled to pass the site during the night at approximately 12:15 A.M. and 4:00 A.M., so views from the trains are normally not possible. A ridge between the highway/railroad corridor and the project site blocks all direct views of the site from most viewpoints west of the high-voltage transmission line. Open views of the proposed action site and the alternative process plant sites are possible, however, in the vicinity of the north endpoints of the proposed rail spur/access road. View



Viewpoint A



Viewpoint B

EXISTING VISUAL SITE CHARACTERISTICS

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 3.7-1a

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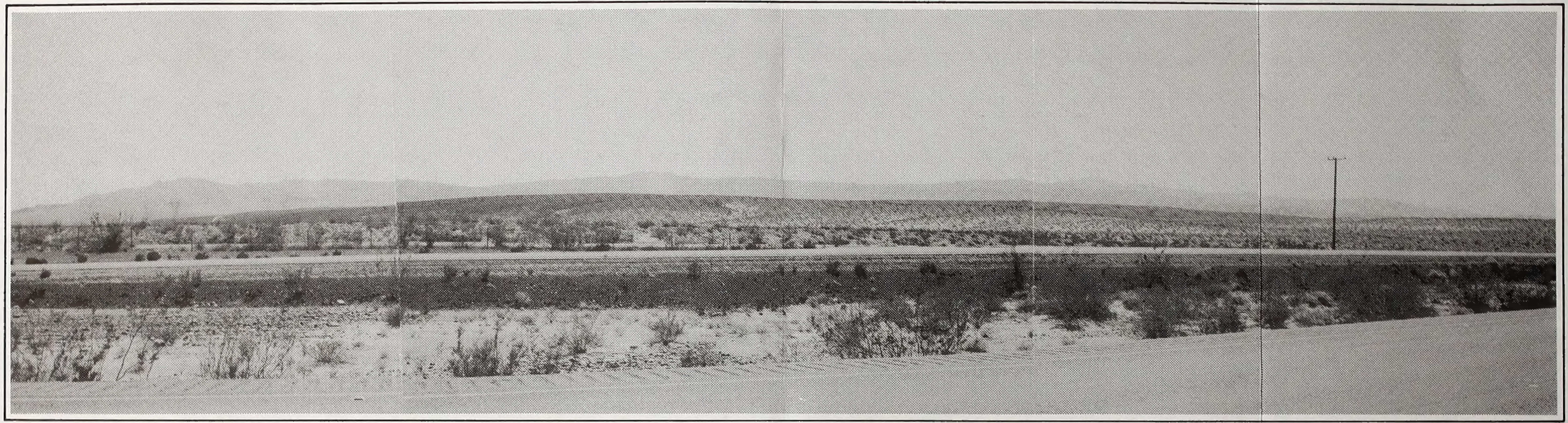
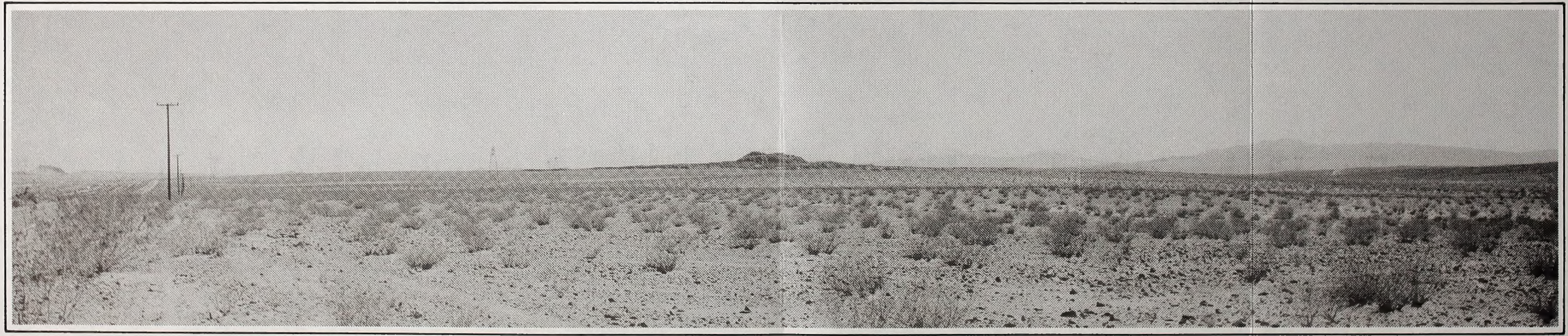


Viewpoint C



Viewpoint D

EXISTING VISUAL SITE CHARACTERISTICS

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 3.7-1b

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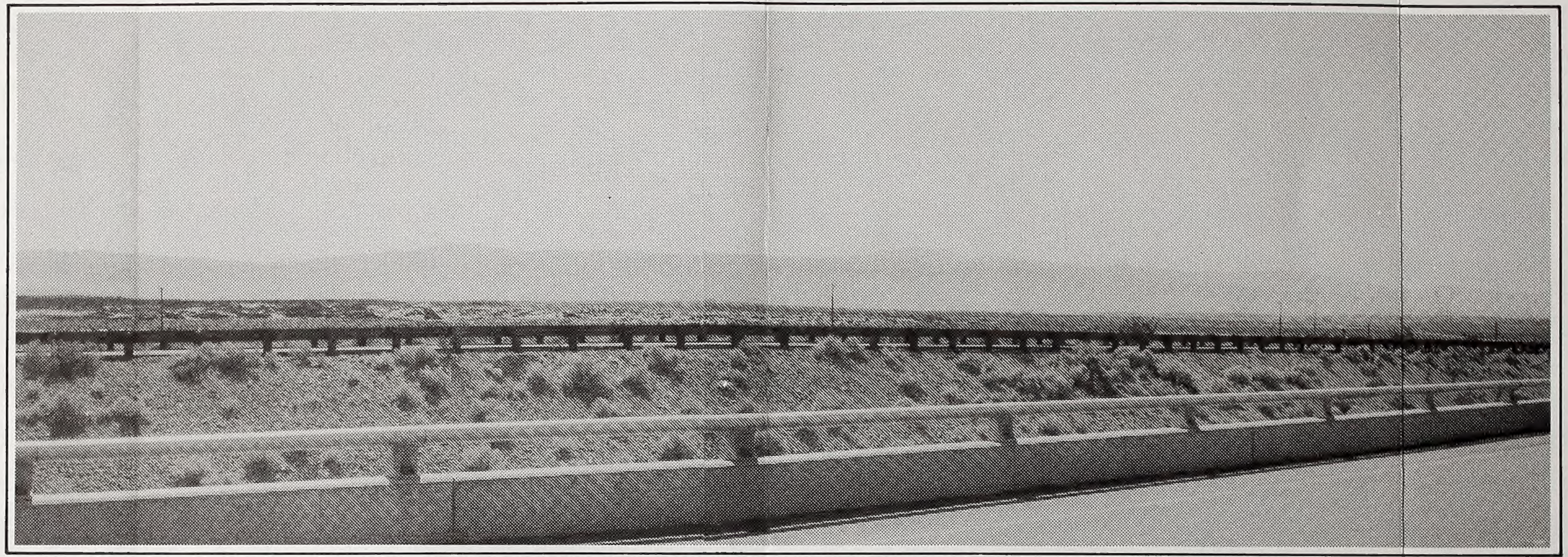
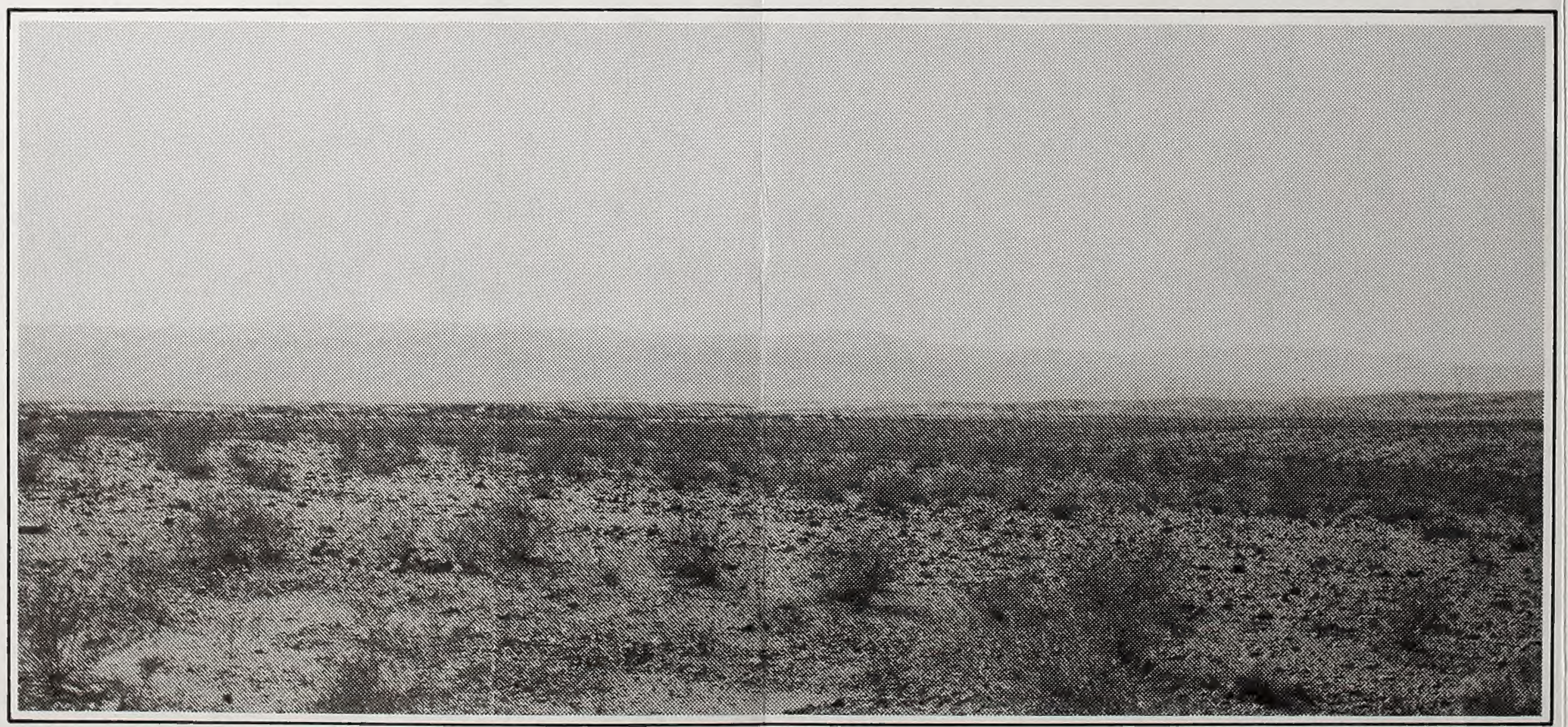


Viewpoint E



Viewpoint F

EXISTING VISUAL SITE CHARACTERIZATION

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FIGURE 3.7-1c

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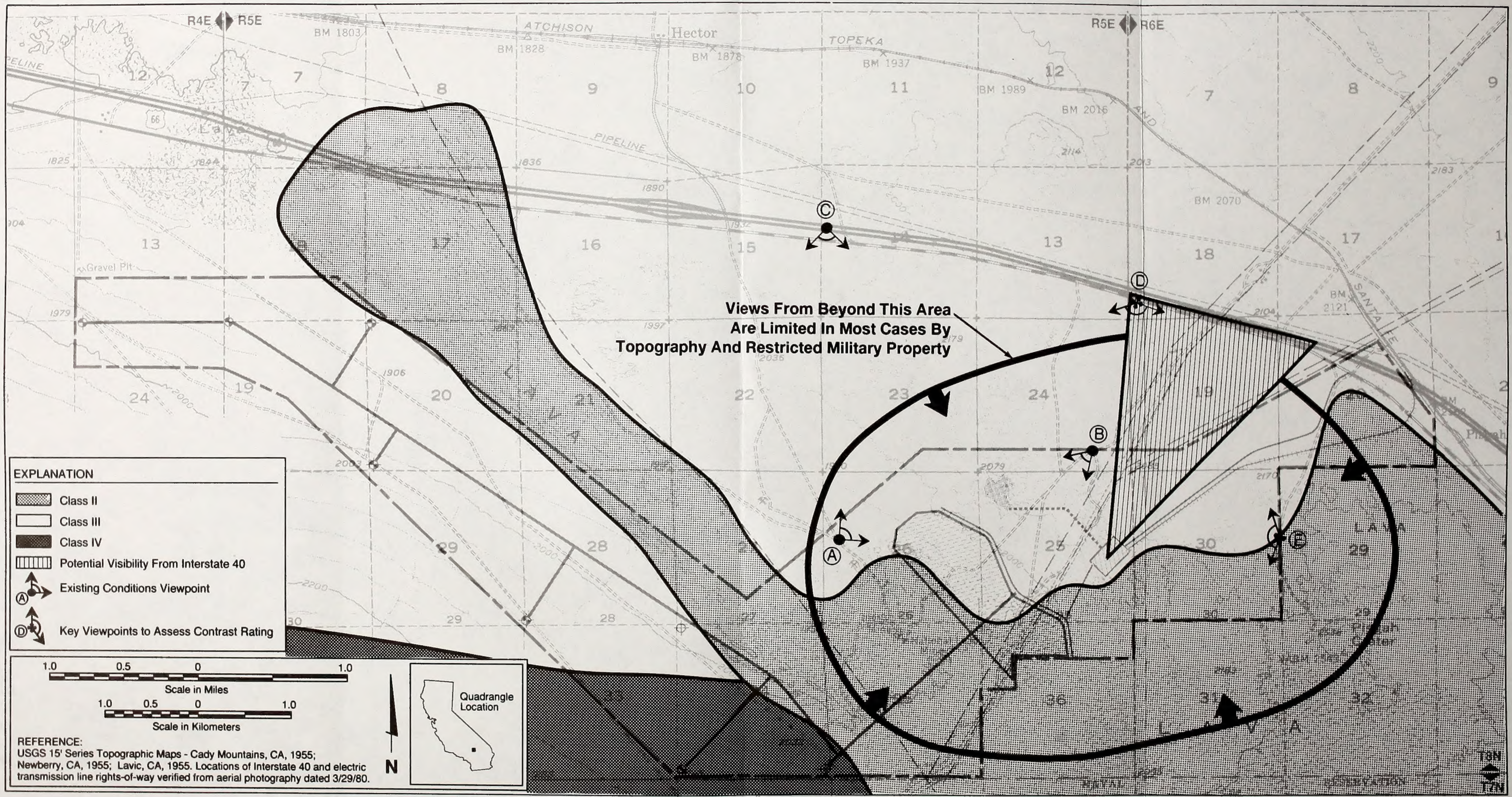
R4E R5E
R5E R6E
ATCHISON
Hector
TOPEKA
PIPELINE
Lavic
66
Gravel Pit
C
D
B
A
E
LAVA
LAVA
NAVAL
RESERVATION
Pisgah Crater
T8N
T7N
Views From Beyond This Area Are Limited In Most Cases By Topography And Restricted Military Property
EXPLANATION
▨ Class II
☐ Class III
■ Class IV
▥ Potential Visibility From Interstate 40
Existing Conditions Viewpoint
Key Viewpoints to Assess Contrast Rating
1.0 0.5 0 1.0
Scale in Miles
1.0 0.5 0 1.0
Scale in Kilometers
REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.
N
Quadrangle Location

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VISUAL RESOURCES SITE VISIBILITY

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California
FIGURE 3.7-2

distances to the spur/road and process plant would range from several hundred feet to approximately two miles (Figure 3.7-2).

The restricted access within the Twenty-Nine Palms military installation limits all potential views from south of the proposed site and alternative process plant sites. Low-flying military aircraft use the area and provide limited additional view access at relatively close distances. Long-range views of the site may be available from higher viewpoints in the mountains which surround the site at distances of 10 to 20 miles. The sites are not likely to be readily visible from the nearest wilderness study area (Rodman Mountains); views to the sites would be approximately ten miles in distance.

VIEWER SENSITIVITY - The BLM VRM Program has defined all views of the project area from the highway/railroad corridor as highly sensitive, which reflects not only high viewer numbers, but an overall high sensitivity to changes in the desert landscape character.

3.7.2 EXISTING PLANS/POLICIES

The BLM system classifies all areas of lava flow in the project area as Management Class II, which stipulates that any contrasts related to the project may be seen but not attract attention (verified by a *low* contrast rating). The remaining project area is in Management Class III, which allows evident contrasts in the landscape that remain subordinate to existing landscape character (a *moderate* contrast rating is associated with landscape changes in this management class).

The CDCA plan includes the following requirements (BLM, 1980):

1) The appropriate levels of management, protection, and rehabilitation on all public lands in the CDCA would be identified, commensurate with visual resource management objectives in the multiple-use class guidelines; and

2) Proposed activities would be evaluated to determine the extent of change created in any given landscape and to specify appropriate design or mitigation measures using the Bureau's contrast rating process.

3) The contrast rating process is a tool used to determine the extent of visual impact that proposed resource management activities would create in a landscape. It serves as a guide for reducing visual impacts to acceptable levels as defined by the visual management objectives and multiple-use class guidelines.

The San Bernardino County General Plan includes the following issues and policies/actions related to scenic resources:

1) goal C-38; "Develop scenic. . .sites of regional value for public enjoyment,"

2) goal C-44; "Protect and maintain regional resources of unique character and value where protection cannot be achieved through other agencies."

3) goal C-48; "Assure dedication of pedestrian and equestrian trails, bikeways, and visual access to major scenic features."

4) goal C-49; "Restrict development along scenic corridors."

5) goal C-50; "Provide for visual enhancement of existing and new development through landscaping."

The county has identified a number of streets and highways as scenic routes which are provided additional recognition and protection through specific policies, but none of these routes are located in the vicinity of the project. I-40 is presently eligible for designation as a State Scenic Highway, but at the present time, no official status declaration has been made (Nakano, 1992: see references for Transportation). The designation of Highway 66 as a National Trails Highway does not require that any special management of scenic quality occur for highway viewers in the project area.

3.8 TRANSPORTATION

3.8.1 EXISTING REGIONAL/SITE FACILITIES

Transportation facilities in the vicinity of the project area include the following (refer to Figures 1.2-1 and 1.2-2).

- I-40, a divided four-lane, limited-access expressway, is the principal east-west roadway in the region (Interstate 15, which connects with I-40 at Barstow, runs approximately 50 miles northwest of the project site). I-40 averages 9,400 vehicles per day ADT (annualized Average Daily Total) at the Hector Interchange approximately two miles west of the project site (Meza, 1991). The design capacity for a multi-lane freeway such as I-40 at a level-of-service C-0 is 1,100 vehicles per lane per hour (or 105,600 vehicles per day per four lanes) (Caltrans Highway Design Manual, Topic 102 — Highway Capacity, 1990). Other interstate highway interchanges in the region are located nine miles west of Hector (Fort Cady Road) and 17 miles east of Hector (Ludlow).

- The National Trails Highway, originally U.S. Highway 66, is a paved, two-lane road paralleling I-40. In the project vicinity, the road serves as a frontage road on the south side of I-40 and connects to I-40 at the Hector Interchange. Traffic counts for the highway at Newberry Road west of the project site totaled 1,300 ADT (San Bernardino County, 1991).

- The Pisgah Crater Access Road, a local graded paved road, provides access to the Pisgah Crater Research Natural Area and the inactive lava mining operation (its total length is approximately two miles).

- The Hector Mine Access Road, a two-mile-long graded gravel road, provides access to the Rheox Hector Mine operation from the National Trails Highway.

- Several unimproved, local access roads presently provide access to the Pilot Plant and the transmission line right-of-way located on and across the proposed site.

- The Atchison, Topeka and Santa Fe Railway (AT&SF) transcontinental mainline parallels I-40 north of the project site, and crosses under the highway just east of the intersection of the National Trails Highway and the Pisgah Crater access road. Traffic on the line experiences numerous fluctuations due to seasonal and economic factors, but as of September 1991, approximately 48 trains per day (including 46 freight trains and two Amtrak passenger trains) were using the facility (Monday, 1991). Two freight trains in each direction per day were classified as local trains which could provide pick-up and set-out service at the Pisgah Siding located adjacent to the I-40 overpass.

- The nearest airport to the proposed action site is the Daggett/Barstow Airport, located 28 miles west of the site. The nearest commercial aviation services are available at the Ontario Airport, located approximately 80 miles southwest of the project area via Interstate 15.

3.8.2 EXISTING PLANS AND POLICIES

The CDCA Plan provides for the development of new access roads and railroad access (upon approval of the authorized officer) within lands designated Multiple-Use Class M (which includes all of the proposed site).

The San Bernardino County General Plan addresses transportation through several goals and policies which pertain to the project area. Issues considered by the County General Plan include ensuring adequate transportation facilities to support planned land uses (D-19); maintaining a minimum level of service C for major roads; and consideration of the accessibility requirements of each land use activity when determining its best location (TC-3a, b, c).

3.9 CULTURAL RESOURCES

Cultural resources consist of buildings, sites, structures, or objects with historical, architectural, cultural, or scientific importance. Projects on federal land or needing a federal permit require consideration of cultural resources under the National Historic Preservation Act. Federal agencies are also charged with addressing cultural concerns of Native Americans under the American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act. In California cultural resources on nonfederal lands are afforded protection by the California Environmental Quality Act.

The project site is approximately 17 miles east of Newberry Springs in San Bernardino County, California (Figure 1.2-2). The project area is known to contain cultural resources.

3.9.1 CULTURAL OVERVIEW

3.9.1.1 PREHISTORY

While much is known about the prehistory of the Mojave Desert, relatively few formal archaeological investigations have been conducted in the southern portion of the central Mojave. As a result, little specific regional information on prehistory is known. General summaries can be found in Stickel and Weinman-Roberts (1980), Warren (1980, 1984), and Warren and Crabtree (1986). A brief summary is provided here.

Although claims have been made for much earlier dates (e.g., Simpson, 1958), sites dating to the Lake Mojave period (12,000 to 7,000 B.P.) serve as the basis for understanding of the earliest undisputed occupation of the Mojave Desert. Lake Mojave period sites are usually open air sites and are limited to the surface, although sites with substantial subsurface deposits have been recently identified in the central Mojave (Jenkins, 1985b). Artifacts of the period include leaf-shaped and long-stemmed, narrow-shouldered points of the Lake Mojave series and short-bladed, shouldered points of the Silver Lake series. A variety of scrapers and flaked stone crescents are also considered diagnostic of the period.

The next identifiable period is that associated with Pinto series points (Warren and Crabtree, 1986). Although period markers, some questions remain concerning their placement in time. Like sites of the preceding period, Pinto sites are typically found in open settings in relatively well-watered locales. The Pinto period signals the beginning of cultural adaptation to the desert, an adaption to the more arid conditions. Grinding tools were incorporated into the artifact assemblage, suggesting that the processing of hard seeds became more important in the subsistence system. It is, however, generally thought that peoples in this time period maintained a mobile subsistence strategy, focused primarily on hunting large mammals.

A time of greater effective moisture in the Mojave dates to approximately 4,000 years before the present (B.P.). It was during this time, the Gypsum period (4,000 to 1,500 B.P.), that more favorable environmental conditions allowed an increase in the population (Elston, 1982). Open sites are in evidence, along with rockshelters and caves. The latter have yielded perishable goods, including basketry and atlatls from the Gypsum period. Habitation sites with well-developed middens are found in association with water and near resource areas. Trade activity appears to have increased in many parts of the Great Basin during the Gypsum period (Bennyhoff and Hughes, 1987).

West of the project and just south of Troy Lake is Newberry Cave. This Gypsum period site contained a number of Elko and Gypsum points, along with perishable items. The collection from this cave is notable for the number of apparent ritual items, including split-twig figures, painted stones, quartz crystals, and pictographs.

Eastgate and Rose Spring points began to dominate artifact assemblages in the Mojave sometime after 2,000 B.P. (Lyneis, 1982:176). In Warren and Crabtree's chronology (1986) these are assigned to the Saratoga Springs period (1,500 B.P. to 750 B.P.). This time period was marked by an increase in regional differences. Anasazi "influence" in the form of painted ceramics extended well into the eastern Mojave. Different influences were felt in the southern Mojave. Here Hakatayan (or Yuman) ceramics originating in the lower Colorado River occur, along with Cottonwood points. This interaction is most evident along the Mojave River, supporting the idea that the Mojave River served as a major trade corridor connecting the coastal California with regions to the east.

The next period, the Protohistoric period (750 B.P. to approximately 1769, the date at which western colonization of what was then Alta California began), was marked by the presence of Desert Side-notched projectile points. Protohistoric period sites include habitation sites with developed middens, located near reliable water sources. Temporary camps and a variety of resource procurement and processing stations also occur.

3.9.1.2 ETHNOGRAPHY

Several of the BLM cultural resource overviews for the Mojave Desert (Hopa, 1980; King, 1976; Knack, 1980) include ethnographic sections that address the aboriginal groups thought to have occupied or at least peripherally included the project area within their territorial limits. Other sources of summary information include work by Bean and Smith (1978) and project-related cultural resource management documents (Dames & Moore, 1985; Cleland et al., 1990). It is known that ethnohistorically the Mojave River Valley served as a route for people and goods. Several groups made use of this corridor across the Mojave Desert, including the Mohave, the Chemehuevi, the Kawaiisu, and the Serrano/Vanyume. Based on available information two groups, the Serrano/Vanyume and the Chemehuevi (Southern Paiute), would have utilized the region around the FCMC project.

SERRANO/VANYUME

The name Serrano, a Spanish word meaning “mountaineer or highlander” has been used to refer to a group of aboriginal peoples occupying the mountains and desert east of Los Angeles. It also encompasses several Takic language speakers: the Serrano, Kitanemuk, Vanyume, and possibly the Tatavium (Bean and Smith, 1978).

It is thought that the Vanyume territory would have included the present project area. Due to their sociopolitical organization and the incomplete archival record, clear territorial boundaries are difficult to determine. It is known that the Vanyume lived along the Mojave River in the central and eastern portion of the Mojave Desert. Very little else is known about the Vanyume. Apparently never numerous, as a result of conflicts with Euroamericans they ceased to exist as a group by 1900 (Bean and Smith, 1978).

The Vanyume have been described as desert dwellers, hunting available fauna and collecting edible desert flora (Beals and Hester, 1971). Politically the Vanyume seem to have differed from the Serrano proper. They apparently maintained good relations with the Mohave and Chemehuevi, who were enemies of the Serrano (Kroeber, 1976).

Since very little is known about the Vanyume, it is Serrano ethnographic information that must be largely relied upon to reconstruct the ethnohistory of the area. The Serrano are generally acknowledged to have occupied an area from the San Bernardino Mountains, to Victorville, and as far east as Twentynine Palms (Bean and Smith, 1978). Like their neighbors, including the Vanyume, the Serrano were hunter-gatherers. Settlement appears to have been largely influenced by the availability of water with most of the population living in small groups near reliable water sources.

Dwellings were circular, dome-shaped structures with frames and thatching. Although fires were used for warmth inside these houses, most cooking was done outdoors. Other structures within an encampment or settlement included a ramada, sweat lodge, and storage granaries (Bean and Smith, 1978).

Prior to contact with Euroamericans the Serrano cremated their dead. The initial ceremony involved the cremation of most of the person’s belongings with cremation of remaining goods performed a month later. A year after the death a Mourning Ceremony lasting seven days was conducted. Several days were spent in food preparation and the rest were devoted to mourning observances and rites such as child-naming (Bean and Smith, 1978; Hopa, 1980).

SOUTHERN PAIUTE/CHEMEHUEVI

The territory of the Numic-speaking Southern Paiute and Chemehuevi extended from southeastern Utah and northern Arizona, southward to the deserts of California and Nevada (Euler, 1972). Now recognized by anthropologists as a separate tribe, the Chemehuevi occupied the southwesternmost region of this territory (Bean and Vane, 1978; Kroeber, 1976).

Before the nineteenth century, it is thought that the Chemehuevi were located in the desert north and west of the Colorado River. Kroeber (1976) places them mostly in Imperial and Riverside counties. By the mid-nineteenth century the Chemehuevi had moved to an area along the Colorado River, settling in territory traditionally held by the Mohave. According to Laird (1976), Tukpera, one of the last High Chiefs of the Teeranewewe (Desert Chemehuevi), led a band that used the area around Daggett.

Dwellings varied in their construction. Chemehuevi structures included brush-thatched and earth-covered houses. These were usually used by a single family. The nuclear family was the primary subsistence unit and probably the basic social unit. Although they did gather seasonally, especially in the fall for a large "festival", the rigors of the environment limited the size of groupings. Laird (1976) recalls that the Cry (mourning ceremony) and the Gathering were the names of two of the times the Chemehuevi came together.

3.9.1.3 HISTORY

Originally claimed by Spain, California was later included as a part of the newly declared Republic of Mexico in 1821. The area was acquired by the United States at the end of the Mexican-American war in 1848, and earned its statehood in 1850. The project area is located in San Bernardino County, which until 1853 was once territory belonging to San Diego County and Los Angeles County (Coy, 1923). Activity and settlement of the region is related to the transportation corridors, the establishment of military outposts, and the development of mining.

The U.S. Government initiated surveys through the territory in an effort to establish roads and railroad routes. The Mojave Road, improved into a government road by Edward F. Beal in 1857, was utilized by the military for travel between Fort Tejon and Fort Mojave. Camp Cady, on the

Mojave River 20 miles east of Daggett, was built as a temporary fort to deal with the Indian attacks on travelers using the Mojave Road. In 1870 a peace treaty was established and the camp was abandoned and sold (Casebier, 1975). The old commissary and quartermaster store stood until destroyed by flood in 1938.

The first railroad through the region was built just south of the Mojave Road in 1883 by the Atlantic and Pacific Railroad. The arrival of the railroad made many parts of the Mojave Desert accessible and development possible. Maintenance depots were located in Barstow and Needles. The Santa Fe Railroad later acquired the rights to the line and it is now part of the AT&SF Railroad.

Many stops and stations were established along the rail line between Mojave and Needles. Newberry, named in 1883, was a main water stop; Troy and Hector, named in 1902, and Pisgah Mountain, named in 1905, were all stops along the main line. As the mining industry began to develop, spur lines were built connecting the mines with the main railway.

Abandoned mines and ongoing mining activities can be found throughout the region. Some of the undertakings are limited to claim markers, while some have dramatically altered the landscape. Modern mining operations within the project vicinity include the Twin Mountain Mine at Pisgah Crater. The mine, which produced cinder (light aggregate), is no longer active. Other local mining activities center on the Hector Mine, currently operated by Rheox, Inc. This mine produces hectorite clay. NL Chemicals (now Rheox Inc.) currently maintains Hector Mine and a processing plant at Newberry Springs. Their mining operations in the area can be traced back to the 1920s.

With the invention of the automobile came the development of highway routes across the country. One such route was the National Trails Highway built in 1914. The road paralleled the Santa Fe Railroad, south of the Mojave Road, from Needles to Barstow then turned south following the Union Pacific Railroad to San Bernardino. The road was paved in the 1930s and became Route 66 (Norris and Carrico, 1978).

Immediately south of the project is the Marine Corps Base and Training Center at Twentynine Palms. The base was first developed as a glider training school in 1941 for the U.S. Army Air Corps. In 1952, Marines were dispatched from Camp Pendleton to the old glider base at

Twentynine Palms to oversee the construction of a new training center. Today, the Air Ground Combat Center at Twentynine Palms, which covers close to 1,000 square miles, ranks as one of the Corps' most modern training facilities (Ludwig, 1989).

Recent mining activities in the project vicinity have centered on exploration for colemanite, a calcium borate mineral. In 1964, exploration for borates in the Hector area identified several colemanite anomolies. The Duval Corporation conducted detailed exploration activities in the area in 1977. Duval delineated a large colemanite deposit, and began preliminary investigations into solution mining techniques. In 1985, these interests were acquired by Mountain States Mineral Enterprises, Inc., who continued the testing program. Blackbird Resources (now Fort Cady Minerals Corporation) first took an interest in the project in 1986. More recently a Pilot-Commercial plant operated by Mountain States Mineral Enterprises and funded by Fort Cady Minerals Corporation has been operated, but is no longer in operation. The buildings in which this pilot plant were operated are still standing on the project site.

3.9.2 INVENTORY

3.9.2.1 ARCHIVAL RESEARCH

PREHISTORY

In order to identify previously documented resources in the area a records search covering a mile-wide area centered on the project area boundaries was conducted at the Regional Information Center of the California Archaeological Inventory at San Bernardino County Museum. Included in the research was the examination of site files to identify historic and prehistoric archaeological sites and a review of historical cartographic sources to identify locations of potential historic sites. The records search was supplemented by a review of the archaeological literature for the study area. In addition, listings of historic properties and sites were checked.

Most of the ten prehistoric sites identified by the records search occur outside the areas slated for disturbance. Of the previously recorded prehistoric resources, only three lithic reduction/quarry areas appeared to be situated within the project limits: CA-SBR-1505, 3516, and 3517.

ETHNOGRAPHY

The ethnographic inventory of the study area was derived from archival research and ethnology studies previously conducted in the region (see Apple and Lilburn, 1992). Although portions of the Mojave Desert have been extensively studied for ethnographic resources by previous investigators, relatively little is known about the project vicinity. Resources reviewed included monographs addressing the entire state, along with documents more focused on the Mojave Desert.

No specific sites were identified within the project area. Native Americans have expressed broad concerns regarding archaeological sites and plant and animal resources of the desert (Bean and Vane, 1978).

HISTORY

The historic inventory was compiled through archival research, examination of cartographic sources, and review of historical literature for the study area. Sources included those documents consulted for the Class I inventory update and records search along with additional materials (Apple and Lilburn, 1992).

Three historic period sites are situated in the project vicinity, including a road eligible for the National Register. The records search identified the National Trails Highway, which crosses the northeastern portion of project. This early transportation route currently serves as a frontage road along I-40. Two other sites associated with transportation are also located nearby. One is the AT&SF rail line, and the other is the Pisgah siding. Only the railroad and the highway are within the proposed area of disturbance.

3.9.2.2 SURVEY RESULTS

Cultural resources surveys were conducted of areas of disturbance at the ore body and proposed facilities (Apple and Lilburn, 1992; Apple, 1993). These investigations resulted in the identification of 44 cultural resource locales. A total of 21 isolated finds and 25 sites were identified.

Of the 21 isolated resources recorded, 17 are prehistoric isolates, typically lithic flakes or cores. The four historic period isolates include single cans or fragments of bottle glass.

Prehistoric sites, composed largely of flaked lithic material, account for 20 of the 25 sites identified during field investigations (Table 3.9-1). Of these 20 prehistoric sites, six are lithic reduction areas or quarries. Project-related disturbance is no longer planned in four of these areas. Other prehistoric resources include 14 lithic scatters, two with tools. Two of these scatters are no longer in the project disturbance area. The remaining five sites are historic period resources and include two previously recorded transportation-related sites: The National Trails Highway (CA-SBR-2910H); and the Atchison, Topeka & Santa Fe (CA-SBR-6693H) railroad. Three historic debris scatters, comprised mostly of cans, complete the inventory.

3.9.3 NATIVE AMERICAN CONCERNS

Native American Religious Concerns are subject to requirements specified in statute and must be considered in all EISs. The BLM has notified potentially affected tribes, which include the Colorado River Indian Tribes and the San Manuel Reservation, soliciting their concerns. There has been no response. BLM records indicate a low sensitivity in the project area with regard to Native American traditional religious and cultural values.

TABLE 3.9-1
CULTURAL RESOURCES SITES IDENTIFIED DURING FIELD INVESTIGATIONS

Site Number	Site Description	Status	Comments
CA-SBR-1505	Lithic reduction area	Not eligible	
CA-SBR-2910H	Highway	Recommended eligible	Applies to segments within project
CA-SBR-3516/3517	Lithic reduction area	Unevaluated	Avoided
CA-SBR-5069	Lithic scatter with tools	Not eligible	
CA-SBR-5598	Lithic reduction area	Unevaluated	Avoided
CA-SBR-6693H	Railroad	Recommended not eligible	Applies to segment within project
CA-SBR-7100	Lithic reduction area	Not eligible	
CA-SBR-7101	Lithic scatter	Not eligible	Avoided
CA-SBR-7102	Lithic reduction area	Not eligible	Avoided
CA-SBR-7103	Lithic scatter	Not eligible	Avoided
CA-SBR-7104/H	Historic debris with prehistoric ceramics	Not eligible	
CA-SBR-7105/H	Historic debris scatter	Not eligible	
CA-SBR-7106	Lithic scatter	Not eligible	
CA-SBR-7107	Lithic scatter	Not eligible	
CA-SBR-7108	Lithic scatter	Not eligible	
CA-SBR-7109	Lithic scatter with tools	Not eligible	
CA-SBR-7110	Lithic scatter	Not eligible	
CA-SBR-7111H	Can scatter	Not eligible	
CA-SBR-7112	Lithic scatter	Not eligible	
CA-SBR-7113	Lithic scatter	Not eligible	
CA-SBR-7114	Lithic scatter	Not eligible	
CA-SBR-7115	Lithic scatter	Not eligible	
CA-SBR-7116	Lithic scatter	Not eligible	
CA-SBR-7134	Lithic scatter	Not eligible	
CA-SBR-1906	Lithic scatter	Unevaluated	Avoided

3.10 PALEONTOLOGICAL RESOURCES

Paleontological resources, including vertebrate, invertebrate, and trace fossils of scientific significance are known to be present in the Mojave Desert near the project area. Fossil resources are considered scientifically significant if they: (1) provide important information on the evolutionary trends of organisms, or relate living inhabitants of the earth to extinct organisms; (2) provide important information on the development of biological communities, or interactions between botanical and zoological biotas; (3) demonstrate unusual or spectacular circumstances in the history of life; or (4) are in short supply and in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in another geographic location. All vertebrate fossils are considered to be of scientific significance.

3.10.1 REGULATORY SETTING

Fossil resources are protected by Federal legislation on Federal lands and by State legislation on California State and private lands, where State or Federal permits or other entitlements are required. Fossil resources, even if they are not specifically mentioned in the text of the legislation, are also protected in that they are important scientifically. This legislation includes the following acts (California Office of Historic Preservation, 1983):

1. Federal Antiquities Act of 1906 (P.P. 59-209; 34 Stat. 225, 16 U.S.C. 432, 433). This act forbids the disturbance of any object of antiquity on Federal lands without a permit issued by a responsible agency. It also establishes criminal sanctions for unauthorized desecration, or appropriation of antiquities.

2. Mineral Leasing Act of 1920 (Section 30). This act requires and provides for the protection of the interests of the United States. Fossils and other natural resource values are commonly regarded as such interests.

3. National Environmental Policy Act of 1969 (NEPA) (P.L. 91-100; 31 Stat. 852, 42 U.S.C. 4321-4327). This act requires that important natural aspects of our national heritage be considered in assessing the environmental consequences of a proposed action.

4. Act of May 24, 1974 (88 Stat. 174) (Sections 3(a), 4(a)). This act provides for the preservation of historical and archaeological data which might be lost as a result of Federal projects or Federally licensed projects or activities. Sections 3(a) and 4(a) require the survey, protection, or recovery of objects or data of scientific significance that are threatened by construction projects.

5. Preservation of Historical and Archeological Data Act of 1974 (PL 93-291, 74 Stat 220, 16 USC 469). This act amended the Reservoir Salvage Act of 1960 and provides for preservation of significant scientific, prehistoric, or archeological data (including relics and specimens) that might be lost or destroyed as a result of the construction of dams, reservoirs and attendant facilities, or any alteration of the terrain resulting from any Federal construction project or Federally licensed project, activity, or program.

6. Federal Land Policy and Management Act of 1976 (FLPMA) (Sections 102(a), 103 (a,c), 201(a), 202(c). This act provides BLM with a basic management mandate for natural resources and requires that scientific values must be addressed in the management of public lands and resources.

7. California Environmental Quality Act of 1970 (CEQA) (13 Public Resources Code: 21000 *et seq.).* This act requires public agencies and private interests to identify the environmental consequences of their proposed actions on any object or site significant to the scientific annals of California (Division I, Public Resources Code: 5020.1).

8. Guidelines for the Implementation of CEQA, as amended May 10, 1980 (14 California Administrative Code: 15000 *et seq.).* These guidelines define procedures, types of activities, people, and public agencies required to comply with CEQA and include definitions of significant effects on a fossil locality (Section 15023, Appendix G).

9. Public Resources Code, Section 5097.5 (Stats. 1965, c. 1136, p. 2792). This code defines any unauthorized disturbance or removal of fossil remains from public land as a misdemeanor.

In addition to this legislation, a 1978 memorandum by G. E. Petty, then Acting Director of the BLM, declared all vertebrate fossils to be of significant scientific value. Further, a 1990 decision by Administrative Law Judge E. C. Lee required the assessment of potentially adverse impacts on vertebrate and plant fossil resources and the development of a plan to mitigate these impacts before granting an application for the construction of a PGT/PG&E Pipeline Expansion Project.

Together these regulations and guidelines establish the need for the identification, evaluation and treatment of paleontological resources. Any projects involving publicly administered land, Federal funding, or other entitlements require compliance with the above-listed legislation.

Baseline information on the paleontological resources of the FCMC project area has been gathered by completing a paleontological map records and literature survey and a field survey.

3.10.2 MAP RECORDS AND LITERATURE SURVEY

The map records and literature survey involved consulting the following professional paleontologists and institutional records: (1) Dr. David Whistler and Ms. Denny Diveley of the Vertebrate Paleontology Section and Dr. Ed Wilson of the Invertebrate Paleontology Section of the Los Angeles County Museum of Natural History (Los Angeles, CA); (2) Mr. Bob Reynolds and Mr. Scott Springer of the San Bernardino County Museum of Natural History (Redlands, CA); and (3) Mr. George Jefferson of the Page Museum (LaBrea Tar Pits, Los Angeles, CA).

This consultation revealed no known fossil localities within the project area or within a surrounding three-mile buffer zone. Fossil localities known from areas of the Mojave Basin beyond the three mile buffer zone, however, indicated that three rock units exposed in the project area had a high or unknown potential to contain significant paleontological resources and a field survey of these rocks was recommended and implemented.

Rock units with a high potential are those rocks which are known to contain scientifically significant fossils. Construction on these rock units can lead to a high potential of encountering and impacting scientifically significant fossils; therefore, a field survey by a qualified paleontologist was carried out in the project area.

See Section 4.1.10 for a discussion of the findings from this field survey.

Rocks with an unknown potential are those rocks that may contain scientifically significant fossils. Field surveys of these rock units have either not been completed or are not available; therefore, the potential of these rocks to contain important fossils is unknown. Construction on these rock units may lead to encountering and impacting scientifically significant fossil resources; therefore, a field survey by a qualified paleontologist was carried out in order to evaluate that potential and develop a mitigation plan, if one is necessary.

The three rock units identified by the map records and literature survey within the project area as having a high or unknown potential to contain scientifically significant paleontological resources are the following:

(1) The Hector Formation: Fossil mammals, including creodonts (archaic, extinct carnivores), camels, weasels, beavers, rhinoceros, rodents, and antelopes dating to the Miocene age (16 to 23 millions years ago) have been found in this formation along the flanks of the nearby Cady Mountains (Miller, 1980; Reynolds, Whistler, and Woodburne, 1991; Woodburne, 1991.

(2) An unnamed lake bed sequence of Tertiary age: These rocks (mapped as QT by Bortugno and Spittler, 1986) may be equivalent in age to either the Hector Formation, or to the younger Manix or Mojave River formations. The Manix Formation accumulated during between about 500,000 to 15,000 years ago and the Mojave River Formation accumulated between about 2.48 million to 0.92 million years ago. The Hector (see above) and Manix formations are known to produce fossils of scientific significance, but the Mojave River Formation does not (Nagy and Murray, 1991). Fossils found in the Manix Formation consist of the remains of freshwater invertebrates; fish and pond turtles; 25 species of birds, including an extinct stork and two extinct flamingos; and 20 species of mammals, including extinct sloths, mammoths, scimitar cats, horses, camels, and bison (Jefferson, 1991). The fine-grained nature of this sequence in the FCMC project area suggested that these rocks had a considerable, as of yet unevaluated, potential to produce significant fossil.

(3) An unnamed alluvial sequence of late Quaternary age. This sequence, informally called the Hector gravels (not to be confused with the much older Hector Formation described above) is depicted on geological maps as Older Pleistocene Alluvium (Bortugno and Spittler, 1987). These rocks, which are much coarser-grained than the unnamed lake bed sequence, are thought to date to about 500,000 years before the present and thus may be equivalent in age to rocks of the Manix Formation (see above). Finer-grained beds in this unit are known to contain fossils and have produced the bones of Pleistocene-age tortoise, kangaroo rat, and pronghorn antelope (Reynolds, 1991).

In addition to these three rock units, there was thought to be considerable potential for significant paleontological resources to be preserved in caves and packrat middens in the project area. Therefore, it was recommended that any caves or middens deemed older than recent age in the area should be critically evaluated by a qualified paleontologist.

3.10.3 FIELD SURVEY

The field survey involved the diligent visual examination of rock outcrops in the project area for fossils of any kind. Well-exposed outcrops just outside the project area boundary that were equivalent to rock units within the boundary were also examined. The field survey revealed that only two of the three rock units initially thought to be exposed in the project area were indeed present: the unnamed lake bed sequence of Tertiary age and unnamed alluvial sequence of late Quaternary age. The Hector Formation was not exposed in the project area. The unnamed lake sequence, after having been observed in the field, is now believed to be equivalent to the Mojave River Formation described above, which does not contain fossils of scientific significance.

3.11 SOCIOECONOMICS

The following section describes the socioeconomic environment in the region potentially affected by the Fort Cady Project. For the discussion below, the socioeconomic environment includes the population, housing, employment, economic, fiscal and public services characteristics of the project area, both current and projected. The project area is located in San Bernardino County approximately 35 miles east of the City of Barstow and 13 miles east of the unincorporated community of Newberry Springs (Figure 1.2-1). To identify differences in regional and local socioeconomic trends in the vicinity of the project, the project area is assessed on three levels: San

Bernardino County, the City of Barstow, and the unincorporated desert communities located near the project site in Census Tract 103.

3.11.1 POPULATION

3.11.1.1 SAN BERNARDINO COUNTY

The Riverside-San Bernardino Metropolitan Statistical Area (MSA) is one of the fastest growing areas in the United States; four of California's ten fastest growing cities are located in San Bernardino County (California Department of Finance, CADF, 1991). In the 1990 census, 1,418,380 people were recorded to reside in the County (Table 3.11-1). Seventy-six percent of these residents live south of the San Bernardino Mountains. The area north and west of the mountains is known as the High Desert Area. The largest concentration of people in the High Desert is in the Victorville/Apple Valley area, comprising approximately 10 percent of the County population. Between 1980 and 1990, San Bernardino County grew approximately 54 percent, and the County is expected to continue to grow, with the population projected to reach 2,171,600 by the year 2010, an increase of an additional 54 percent (Southern California Association of Governments, SCAG, 1989).

3.11.1.2 BARSTOW

The City of Barstow is located approximately 70 miles north of the City of San Bernardino on I-15 (Figure 1.2-1). In 1990, Barstow had 21,472 residents. Along with Victor Valley, Barstow is one of two major concentrations of population in the western High Desert. Barstow grew 30 percent between 1980 and 1990, which was slower than the County-wide rate of 54 percent. This growth was largely due to expanded military activities at Fort Irwin and the Marine Corps Logistics Base (City of Barstow Planning Department, BPD, 1989). From 1990 to 2010, Barstow is expected to grow approximately 81 percent, which would exceed the projected county rate of 53 percent (SCAG, 1989). Projected population growth can largely be attributed to expansion of military activities, support industries for the personnel at Fort Irwin and the Marine Corps Logistics Base, commercial projects, expansion of retail and wholesale facilities at the new Factory Exchange Outlet Mall, and continued growth of tourist- and highway-dependent services.

TABLE 3.11-1
STUDY AREA
POPULATION TRENDS AND CHARACTERISTICS

	San Bernardino County	Barstow	Census Tract 103
Total Population			
1980[1]	919,700	17,750	3,160[5]
1990[2]	1,418,380	21,472	8,864
Population Growth 1980-90	54.2%	30.0%	180.5%
1991[3]	1,471,300	21,850	N/A
Population Forecasts			
1990	1,418,380	21,472	N/A
1910[4]	2,171,600	38,816	N/A
Projected Population Growth	53%	80.7%	N/A
Ethnic Composition, 1990			
White	862,113 (60.8%)	11,550 (53.8%)	8,102 (74.4%)
Black	109,162 (7.7%)	2,120 (9.9%)	1,812 (16.6%)
American Indian, Eskimo, Aleutian	10,018 (0.7%)	365 (1.7%)	121 (1.1%)
Asian and Pacific Islander	55,367 (3.9%)	667 (3.1%)	412 (3.8%)
Other	3,118 (0.2%)	44 (0.2%)	441 (4.1%)
Hispanic	378,582 (26.7%)	6,726 (31.3%)	1.317 (12.1%)

Notes:

[1] Source: 1980 Census Report

[2] Source: 1990 Preliminary Census Report

[3] Source: State Department of Finance Population Estimates

[4] Source: Adopted Growth Management Forecast - SCAG 2/89

[5] For the 1990 census, 1980 census traces 103 and 89.02 were combined. A corresponding adjustment has been made to the 1980 data to allow comparison.

N/A = Not Available.

3.11.1.3 COUNTY COMMUNITIES

The project site is located near four unincorporated communities. Three of these communities are within Census Tract 103, which generally reflects the decentralized social conditions of the rural desert areas in the project vicinity.

The closest community to the project area is Newberry Springs. It is located approximately 24 miles east of Barstow and 13 miles west of the project site. Newberry Springs has an estimated population of 4,000 covering 117 square miles between I-40 and Interstate 15 (Feary, 1991). The community of Daggett is located 28 miles east of the project site along I-40 and has approximately 800 full-time residents (Daggett Community Service District, DCSD, 1991). The community of Yermo, which primarily supports the adjacent Marine Corps Logistics Base, is similar in size to Daggett and is located about ten miles west of Barstow along I-15. Yermo is not located in Census Tract 103. Ludlow is a small desert community of about 100 residents located 20 miles east of the project site.

3.11.1.4 ETHNICITY

The majority of the residents in Barstow are Caucasian. They comprise 67.1 percent of the City's population (Table 3.11-1), which is less than their representation County-wide (73.0 percent). The ethnic composition of the unincorporated desert communities east of Barstow may be generally represented by the demographic characteristics of Census Tract 103. Whites represent a greater majority in the eastern desert, comprising 74.4 percent of the population in Census Tract 103. In recent years, the proportion of Whites in the Barstow population has decreased, reflecting an influx of other ethnic groups. The second largest ethnic group is persons of Spanish/Hispanic origin. For census tabulation, persons of Spanish/Hispanic origin are a self-designated category counted separately from race. People of Hispanic origin represent 31.3 percent of the City's 1990 population, more than County-wide (26.7 percent) and far more than in Census Tract 103 (12.1 percent). Blacks make up 10.5 percent of Barstow, which is about 2 percent more than the County-wide composition, but less than the 16.6 percent in Census Tract 103. (The percentages of ethnic groups add to more than 100 due to members of the population being of mixed race.)

3.11.2 HOUSING

Housing characteristics are presented in Table 3.11-2. San Bernardino County had 542,443 housing units in 1990, 1.6 percent of which are in Barstow. Approximately 67 percent of the units County-wide were detached single-family homes. Barstow had more multi-family units and mobile homes; detached single family homes made up only 56 percent of the housing units. Barstow housing units are predominantly occupied by families, which make up 72 percent of its households (U.S. Bureau of the Census, 1990). Census Tract 103 has 3,880 housing units, the majority of which are mobile homes.

TABLE 3.11-2
HOUSING CHARACTERISTICS

	San Bernardino County				Barstow			
Characteristics	**1980[1]**	**1990[2]**	**% of Total**	**Change 1980 to 1990**	**1980**	**1990**	**% of Total**	**Change 1980 to 1990**
Single-Family Detached	—	361,598	(66.8)	—	—	4,794	(56.3)	—
Single-Family Attached	—	22,284	(41)	—	—	252	(3.0	—
Multi-Family (2+Units)	—	111,503	(20.6)	—	—	2,453	(28.8)	—
Mobile Homes	—	42,983	(7.9)	—	—	911	(10.7)	—
Other	—	3,965	(0.7)	—	—	99	(1.2)	—
Total Housing Units	**370,155**	**542,433**		**56.5%**	**6.174**	**8,509**		**37.8**
Owner-Occupied	—	294,248	(54.3)	—	—	4,049	(47.6)	—
Renter-Occupied	—	170,489	(31.4)	—	—	3,602	(42.3)	—
Median Home Value	$63,000	$129,200	N/A	105%	$50,500	$71,900	N/A	42.4%
Vacancy Rate	—	14.3	N/A	—	—	10.1%	N/A	—
Household Size	2.82	2.97	N/A	5.3%	3.4	2.79	N/A	-17.9%

Notes:

[1] Source: 1980 Census Report

[2] Source: 1990 Preliminary Census Report

N/A Not Applicable

The percentage of owner-occupied units (47.6 percent) was also lower in Barstow, possibly reflective of the transient nature of military assignments at Fort Irwin and the Marine Corps

Logistics Base. Housing growth in Barstow was primarily in renter-occupied units. Owner-occupied housing made up approximately 48 percent of the total units in Barstow, as opposed to 54 percent County-wide, with renters occupying the remainder of the units. There was virtually no growth in the stock of renter-occupied housing in Barstow from 1980 to 1990. Approximately 70.3 percent of the total units in Census Tract 103 are renter-occupied.

Vacancy rates in Barstow (10.1 percent) were lower than in San Bernardino County as a whole (14.3 percent). However, the Barstow vacancy rate increased substantially from 7.3 percent in 1980 to 10.1 percent in 1990. The vacancy rate in Census Tract 103 is high at 25.3 percent.

In Barstow, median home prices are far less than are values County-wide, which are influenced by the rising housing prices near San Bernardino and Victor Valley. The fast growth in San Bernardino County has seen housing prices rise dramatically since 1980 when the median owner-occupied housing value was $63,000. The median housing cost rose to $129,200 in San Bernardino County in 1990. In sharp contrast, the median cost of a Barstow home in 1990 was $71,900. The cost of housing in Barstow has escalated less rapidly from a 1980 median price of $50,500 (BPD, 1989). The median home price in Census Tract 103 is $71,600, approximately the same as Barstow.

Housing in Newberry Springs reflects the decentralized and agricultural foundations of the community. Locally-mandated limits on new water wells and sewage service limit housing growth. Rental units exist, but their availability is limited (Amadeo, 1991a). Consequently, while steady growth is expected to continue, fast expansion of the Newberry Springs housing stock is not anticipated. Housing in Yermo and Daggett generally reflects the needs of the adjacent military bases. Housing growth in these areas is slow; no major housing developments are anticipated in these areas (City of Barstow Economic Development Department, BEDD, 1991).

Information on per capita income in the study area is available for 1987. In 1987, the per capita income for San Bernardino County was $10,815; Barstow's per capita income was lower at $10,144 (U.S. Bureau of the Census, 1987).

3.11.3 EMPLOYMENT AND ECONOMICS

Regional employment in the San Bernardino-Riverside MSA is diversified with services, government, trades and manufacturing comprising the largest employment sectors. The mining industry is the largest economic sector of the San Bernardino County economy, and is particularly important to the economy of the desert communities in which mining facilities are located. As shown in Table 3.11-3, the mining industry employs 1,400 people throughout the area, most of whom are located in San Bernardino County. Mining employment is expected to grow to 1,600 by 1996 and employment in the mining sector has remained fairly constant since 1982 (California Employment Development Department, CEDD, 1991).

TABLE 3.11-3
EMPLOYMENT
RIVERSIDE - SAN BERNARDINO MSA
1989-1996 ANNUAL AVERAGES

	1989	1990	Forecast 1996	% Change 1989-96
Total Employment, All Industries	709,100	761,600	927,300	30.8
Agriculture, Forestry, Fisheries	20,900	21,700	21,000	0.5
Non-agricultural Total	688,100	739,900	96,300	31.7
Non-agricultural Goods Producing Industries	154,900	158,700	198,300	28.0
Mining	1,400	1,400	1,600	14.3
Construction	65,300	67,500	88,200	35.1
Manufacturing	88,200	89,800	108,500	23.0
Non-agricultural Service Producing Industries	533,300	581.200	708,000	32.8
Transportation and Public Utilities	33,300	35,400	46,300	39.0
Trade	170,500	184,200	225,900	32.5
Finance, Insurance and Real Estate	29,800	32,600	38,200	28.2
Services	162,000	179,500	223,400	37.9
Government	137,800	149,500	174,200	26.4
San Bernardino County Employment Rate	**July - 1991**		**July - 1990**	
Civilian Labor Force	636,800		614,400	
Employment	580,600		575,600	
Unemployment	56,200		38,800	
Unemployment Rate	8.8%		6.3%	

Although precise data are not available, an on-going survey of mining operations with the California Department of Mines and Geology confirmed the existence of approximately 118 mines in San Bernardino County. Approximately 55 percent of the confirmed mines are in operation. Of those operating, 25 percent are located on public land, with the remainder on private land (San Bernardino County Planning Department, SBPD, 1991). It is expected that the total number of mines in San Bernardino County well exceeds the number of recently confirmed mines (Rush, 1991).

Barstow's economic vitality is largely the result of its proximity to railroad and interstate highway transportation facilities, Fort Irwin and the Marine Corps Logistics Base. It was originally founded for its geographic advantages by Atchison, Topeka, and Santa Fe Railroad and lies at the intersection of Interstates 15 and 40. Situated between Los Angeles and Las Vegas, roadside business such as motels, restaurants, and retail stores catering to travelers are an important source of employment. The largest area employers in the Barstow area are listed in Table 3.11-4.

TABLE 3.11-4
LARGEST EMPLOYERS IN THE BARSTOW AREA

Employer	Employees	Payroll (in millions)
Fort Irwin National Training Center	Military: 4013 Civilian: 628	$141.0
U.S. Marine Corps Logistics Base	Military: 526 Civilian: 2,056	$73.3
Santa Fe Railway Company	802	$23.7
Barstow Station Tourism	350	$13.2
Bendix Field Engineering	286	$13.2
Luz Engineering Solar Plants	433	$26.2
Southern California Edison	125	$5.8
Contel	53	$1.7
Union Pacific Railway Switching Yard	26	$0.8

Source: Barstow Chamber of Commerce, 1991

Sixteen manufacturing plants are located in the Barstow area. Leading manufactured products are non-metallic minerals such as sand and gravel. Ninety percent of the rare earth minerals needed in the production of television equipment are mined in the High Desert Area. Other minerals mined are gold, silver, lead, zinc, copper, titanium, borate, hectorite, platinum, molybdenum, bentonite, lime, salt, talc, cement and a variety of commercial rock (Barstow Area Chamber of Commerce, BCC, 1990). The largest manufacturing employer in Barstow is Rheox, Inc., which employees 36 workers in its processed hectorite clay mining facility immediately adjacent to the project site (BEDD, 1991).

The economy in Daggett and Yermo is generally driven by direct employment from the military bases, indirect services for the military, and tourism. The economic base in Newberry Springs is founded on agriculture, mining, and retirement-related industry (Feary, 1991). Agricultural expansion is limited by a prohibition of large-scale water consumption in the vicinity of Newberry Springs/Harvard (San Bernardino County General Plan, SBGP, 1990).

During June 1991, unemployment in San Bernardino County grew to 8.8 percent. This reflects a substantial increase from 6.3 percent for the previous year (EDD, 1991).

3.11.4 FISCAL ANALYSIS

FCMC's property is located in unincorporated San Bernardino County territory, and the County currently is the only jurisdiction levying property taxes on it. No other jurisdiction in the region, such as a city government or special district like a school or community service district, includes the property within their jurisdictional boundaries; therefore, all property taxes currently levied on the site go directly to the County. According to FCMC's tax records, the property in 1991 had a assessed value of $362,303, of which $262,303 was for land and $100,000 was for improvements (note that under Proposition 13, the assessed value of a property is its market value as of the latest change of ownership or improvement, commencing in 1978, with annual adjustments of up to 2 percent per year; accordingly, the current assessed value may not reflect the property's current market value). Total property taxes on the site for the year were $3,262.03. By way of comparison, in FY 1989-90, the total assessed value of real and personal property in San Bernardino County was over $14 billion and property taxes levied that year totaled over $141,000,000 (State Controller, 1991a).

As shown in Table 3.11-5, sales and use taxes were the primary source of general fund revenues for Barstow, followed by intergovernmental transfers from other agencies.

TABLE 3.11-5
GENERAL FUND REVENUE FISCAL YEAR 1989-1990

	Revenue	**Percent of Total**
Revenue		
Property Taxes	771,812	12.4
Sales and use taxes	2.652,295	42.6
Transient occupancy taxes	533,479	8.5
Franchise taxes	331,435	5.3
Business license taxes	161,542	2.6
Other taxes	32,491	0.5
Licenses and permits	108,472	1.7
Fines and penalties	72,060	1.2
Use of money and property	154,839	2.5
From other agencies	975,928	15.7
Charges for current services	221,839	3.6
Redevelopment agency	86,874	1.4
Misc. and impact taxes	116,644	1.9
Total Revenue	6,219,710	100.0

Source: Barstow Auditors Report, 1991.

Population growth generally results in a corresponding increase in the labor force and the number of people employed. Growth of these sectors affects general fund revenues within the study area in both San Bernardino and the Barstow area. Job growth increases personal income, which in turn increases sales and property tax receipts. Corresponding retail growth, especially important along I-15 through Barstow, also influences tax receipts; for example, approximately half of Barstow's growth in retail tax receipts during the last two years was due to growth in sales at a new factory outlet mall just west of Barstow adjacent to I-15. The mining industry is also an important contributor to the fiscal condition of San Bernardino County, providing it with the largest economic contribution with corresponding fiscal benefits.

3.11.5 PUBLIC SERVICES

A full range of public facilities, community services and utilities are provided by the City of Barstow within its incorporated limits. More limited services are provided in the surrounding unincorporated areas of San Bernardino County by local services districts. Public services in the unincorporated desert communities are normally limited to those that can be supported by a small local population.

Barstow has one full service hospital with approximately 61 physicians and surgeons. Health services for the unincorporated areas are located in Barstow.

The Barstow Unified School System has eight active elementary schools, two junior high schools, and Barstow and Central High Schools. The school system serves approximately 7,400 students and employs 745 people; student-teacher ratios are targeted at approximately 30:1. Barstow has one two-year community college.

The unincorporated communities, including Newberry Springs, are served by the Silver Valley Unified School District, which has 3 elementary schools, two middle schools, Silver Valley High School and one continuation high school. Students total 2,140 and the district has 244 employees.

Law enforcement at the project site would be provided by the County Sheriff's office. The sheriff's office has 44 uniformed officers and a patrol area extending 78 miles east of Barstow; the Sheriff's office has responsibility for the largest district in the country (Von Oosbree, 1991). Fire and emergency services would be provided by the Barstow Fire Department located in

Barstow, supplemented by the 15-member Newberry Springs Volunteer Fire Department. The response time of the Newberry Springs Volunteer Fire Department to the project site is approximately 25 minutes (Worsey, 1991). The BLM provides an emergency response capability to wildfires on public lands; their fire station is located in the Victorville/Apple Valley area (Castle Mountain EIS, 1985).

Services in Newberry Springs are governed by the Newberry Springs Community Services District. The community does not have a sewer or water district. Residents must provide for their own septic systems and drinking water from individual wells. A San Bernardino County ordinance prohibits drilling new water wells for agriculture, or major industrial or residential projects in Newberry Springs.

3.11.6 UTILITIES

Electrical power in the project area is currently provided by Southern California Edison via their 12-kV transmission line that runs parallel to National Trails Highway. The nearest substation is approximately 17 miles away in western Newberry Springs. There is an extension of the transmission line that serves the Rheox, Inc. Mine, which is immediately adjacent to the project site.

The nearest natural gas facility to the project area is Pacific Gas and Electric's 34-inch mainline located on the north side of I-40. Natural gas transmitted in the main line originates in Topock, Arizona, near Needles, California, at the Arizona-California border and serves customers throughout California (Frihoe, 1992).

Section 4.0

Environmental Consequences and Mitigation

4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION

The evaluation of significance in the following sections reflects the CEQA and NEPA regulations. The potential for impacts to be significant is identified based on non-compliance with regulations and/or professional judgment. Impacts may be the result of direct and/or indirect effects. The significance of an impact is categorized as being one of the following:

- ***Adverse but not significant*** — this means the impact may result in some damage to the environment, but that the damage is minor (e.g., 1 dBA increase in sound level at a sensitive receptor), or small, relative to the available resource base (e.g., loss of biological habitat that contains no sensitive species and has a widespread distribution); no mitigation is required for this type of impact.

- ***Potentially significant but mitigatable to not significant*** — this means that the impact is of potential concern because of the size of the impact (e.g., 10 dBA increase in sound level at a sensitive receptor) or the sensitivity of the resource (e.g., demand on groundwater supplies in an area where the basin is in a condition of overdraft); however, mitigation is available to reduce the impact to a level of not significant (e.g., loss of biologically significant habitat is often mitigated by purchase and preservation/enhancement of the same habitat offsite in accordance with replacement ratios established by the regulatory agency with responsibility for the resource).

- ***Potentially significant and not mitigatable to not significant*** — this means that the impact is of concern because of the sensitivity of the resource and available mitigation is insufficient to reduce the impact to a level of not significant (e.g., an ambient air quality standard is exceeded and current technology is inadequate to reduce project emissions to a level such that the standard will not be violated); under CEQA, this type of impact requires the lead agency to prepare a Statement of Overriding Considerations (i.e., project benefits outweigh the significant damage to the environment) in order for the project to be approved.

- ***Beneficial*** — this means that the impact has a benefit to the physical, biological, or social environment (e.g., creation of job opportunities in an area where unemployment is a problem).

Environmental impacts identified as potentially significant are based on the following criteria:

- GEOLOGY
    - Major change in topographic character of an area (e.g., elimination of a hill)
    - Exposure of people or structures to major geologic hazards (i.e., fault crossings, subsidence, liquefaction, slope stability, seismicity, corrosive soils, erosion)
    - Substantial increase in rate of natural erosion

- HYDROLOGY
    - Deterioration of water quality to a level of exceedance of proposed or existing federal and state standards
    - Alterations of watershed and/or stream channel geometry or gradients such that substantial undesirable effects occur (e.g., flooding, siltation, erosion, aggregation, degradation, side-cutting)
    - Exceedance of the safe yield of a groundwater aquifer
    - Degradation of water quality that would impede the beneficial use of groundwater as a result of pollutants reaching a sensitive aquifer
    - Contamination of a public water supply
    - Substantial interference with groundwater recharge (taking into account groundwater quality, groundwater use, Basin Plan, overdraft conditions, etc.)

- AIR QUALITY
    - Exceedance of federal or state ambient air quality standard
    - Exceedance of air pollution control district emission threshold

- NOISE
    - Increase in noise level at sensitive receptors exceeds 3 dBA and exterior noise levels exceed 65 dBA

- **BIOLOGICAL RESOURCES**

  Plant Life

  - Loss or degradation of vegetation that is not common in the region
  - Eliminate individuals or populations of sensitive plant species (e.g., rare, threatened or endangered)

  Animal Life

  - Loss or degradation of wildlife habitat that is not common in the region
  - Eliminate individuals or populations of sensitive animal species (e.g., rare, threatened or endangered)
  - Loss or degradation of habitat of sensitive species
  - Cause permanent change in the movement corridors or patterns of any resident or migratory wildlife species

- **LAND USE/RECREATION**
  - Conflict with existing plans, policies, or goals of the jurisdiction where it is located
  - Conflict with established recreation uses
  - Create a hazard to existing flight paths
  - Project located in area of high risk of aviation accident and consequences of accident could cause loss of human life at project

- **VISUAL RESOURCES**
  - Elimination of dominant visual elements in natural scenic qualities of an area
  - Introduce a dominant visual element or contrast, inconsistent with the local scenic environment, which is within an identified sensitive viewshed corridor

- **TRANSPORTATION**
  - Reduction in Level of Service (LOS) to E or less
  - Access for emergency vehicles (police, fire, paramedics) is prohibited and no alternative access is available
  - Substantial increase (10 percent) in potential number of vehicle accidents

- **CULTURAL AND PALEONTOLOGIC RESOURCES**
    - Impact to burials or resources on or potentially eligible for National Register of Historic Places
    - Disrupt or adversely affect a prehistoric or historic archaeological site or a property of historic or cultural significance to a community or ethnic or social group, or a paleontological site except as a part of a scientific study

- **SOCIOECONOMICS / PUBLIC SERVICES**
    - Increase in population in excess of forecasted growth
    - Displacement of a large number of people
    - Demand for housing exceeds available supply
    - Demand for accommodations of temporary work force exceeds supply
    - Substantial consumption or waste of energy
    - Demand exceeds capability of service to provide for project needs
    - Interfere with emergency response plans or emergency evacuation plans

4.1 PROPOSED ACTION

4.1.1 GEOLOGY

4.1.1.1 CONSTRUCTION IMPACTS

Construction-related impacts of proposed facilities and associated pipelines involve modification of the site terrain and possible drainage control measures. These may result in a small local increase in soil erosion potential in affected areas. Potential geologic impacts resulting from construction of the proposed action include modification of topography, modification of drainage patterns, and increased susceptibility to erosion.

MODIFICATION OF TOPOGRAPHY

Impacts from the construction of proposed facilities include modification of existing topography. Such modification would be minimal except in the proposed gypsum deposition area, where earthen berms would be constructed by the excavation of near-surface materials to form the berms. However, the berms and the excavated areas would be relatively small and the excavation would be shallow. Consequently, this impact would be adverse but not significant.

MODIFICATION OF DRAINAGE PATTERNS

Minor alteration of drainage patterns in two parts of the project area is expected to take place as the result of the construction of proposed facilities. Construction of the process plant and rail spur would cause some minor alteration in the wash located in that part of the project area, and construction of the gypsum deposition area would alter a small area of runoff from the low hills in the north-central project area. Because the area of altered drainage is relatively small, and the altered drainages are relatively minor, this impact is considered adverse but not significant.

INCREASED SUSCEPTIBILITY TO EROSION

Construction of the proposed action facility would result in areas of disturbed soil that are more susceptible to erosion by water or wind. This would be considered a potentially significant adverse impact. However, the impact could be rendered not significant by reclaiming disturbed areas to reduce erosion potential.

4.1.1.2 OPERATION IMPACTS

Potential seismic impacts related to the operation of the project include induced seismicity by injection and/or subsidence, and surface rupture due to induced seismicity and/or subsidence. Potential geologic impacts resulting from operation of the proposed action include modification of existing topography, and subsidence due to mining operations and groundwater extraction.

SUBSIDENCE. The ore body is composed of approximately 12 percent colemanite crystals interbedded primarily with anhydrite in a matrix of mudstone. Mining would result in removal by dissolution of the colemanite with a concurrent increase in porosity of the formation. Because the colemanite generally has not been observed to occur in large masses, large voids are not expected to form in the subsurface during mining. Subsidence due to this increase of porosity in the ore body is not expected to occur because of the following factors: (1) the bridging effect of the interstitial mudstone in the ore body, and (2) the strength and thickness of the overlying well-indurated (i.e., hardened) mudstones.

If subsidence were to occur, it would occur uniformly over a relatively broad area for the same reasons cited above. The maximum amount of subsidence would not exceed 12 feet, and is likely to be much less, if there is any subsidence at all. The impacts of subsidence on project facilities would be minimal, due to the broad, uniform nature of the subsidence, and would be limited primarily to possible disruption of drainage patterns within the area of subsidence. The effect of such potential disruption is mitigatable using standard engineering measures. This impact is adverse but not significant, for the reasons stated above.

Extraction of groundwater for use in process operations is planned to take place at an average rate of 100 gallons per minute (gpm) as part of the proposed action. Groundwater extraction would take place from the water wells located on the west side of the Pisgah Fault, in the western end of the project area. Based on available data, the hydrologic effects of this extraction have been analyzed. The analysis is presented in Section 3.2, and indicates that drawdown would range from roughly 7 feet to a maximum of 45 feet, depending on the number of pumping wells in operation. This lowering of groundwater levels could potentially cause relatively minor subsidence of the ground surface. This type of subsidence, when it occurs, typically occurs uniformly over a relatively broad area. The impact of such subsidence, should it occur, would be negligible. This impact is therefore considered adverse but not significant.

INDUCED SEISMICITY. In addition to naturally-occurring tectonic earthquakes, it is possible to trigger earthquakes by injecting fluids under high pressures into wells. A fault or fracture in close proximity to a high-pressure injection well becomes a potential location for induced earthquakes. As fluid pore pressure increases within the reservoir, the apparent strength of the fault decreases, which increases the potential for induced earthquakes.

Numerous cases of earthquakes related to fluid injection have been documented (U.S. Geological Survey, USGS, 1987). The majority of these cases are associated with water-flooding operations for the purpose of secondary recovery of hydrocarbons. This process usually entails injecting fluids at high pressures into small, confined reservoirs with low permeabilities. Wells are generally deep, greater than 3000 feet in depth. Well-documented cases of injection-induced seismicity associated with secondary recovery operations include Rangely, Colorado (maximum earthquake of magnitude, M, 3.1) and the Permian Basin oil and gas fields in west Texas (maximum earthquake of M 4.4, USGS, 1987).

Limited cases of induced seismicity have been associated with waste disposal and solution mining (USGS, 1987). The Rocky Mountain Arsenal site near Denver, Colorado, is the best documented case that has conclusively shown injection to be associated with significant adjacent seismicity.

Unusually high levels of seismicity occurred within a five-km radius of a deep (12,045 feet) waste disposal well, which bottomed in vertically fractured pre-Cambrian gneiss (Evans, 1966). Microearthquake activity was also triggered during solution mining for salt near Dale, New York (USGS, 1987). As many as 80 earthquakes per day were concentrated within one km of an approximately 1,400 feet deep injection well in an area where the previous record of activity was less than one event per month (Fletcher and Sykes, 1977). The well was the closest of six wells to the Claredon-Linden Fault, located approximately 50 meters from the fault. These induced events were small, ranging from M -1.0 to 1.0. Seismicity continued in the Dale brine field for as long as elevated pore pressure was maintained. At Rangely and Denver, Colorado; Mitsushiro, Japan (where researchers specifically triggered earthquakes by fluid injection); and Dale, New York, the bottom of the wells used for fluid injection were located in or very close to major fault zones.

Injection-related induced seismicity is not expected to occur within the project area or vicinity as a result of fluid injection for several reasons: (1) it is unlikely that the fluids would migrate to the nearby faults due to the containment of the borate ore body provided by an envelope of indurated mudstone and the distance of the faults from the well field; (2) in the review of the geologic logs for the exploratory boreholes, evidence of fracturing of the ore zone was not found; (3) the quantities of fluids injected into the ore body would be relatively limited and would be subsequently removed by extraction; and 4) fluids were injected during the pilot testing without induced seismicity. Therefore, because there is a low potential for induced seismicity, this impact is considered adverse but not significant.

Although it is unlikely that injected fluids would reach the Pisgah Fault or the small, unnamed fault (Fault B), the potential exists for the inducement of microearthquakes due to hydrofracturing of the reservoir rocks in the immediate vicinity of the injection well bottoms if injection pressures exceed the strength of the ore body rock. Injection pressures to be used in the proposed mining process would be below the levels believed to produce hydrofracturing; however, if microearthquakes are generated by the injection, the injection pressures can be decreased until the occurrence of microearthquakes is diminished. These microearthquakes, however, would probably not be detected unless a microseismic network is placed in the vicinity of the well field. The impact from microearthquakes, should they occur, would be adverse but not significant due to the low intensity of such earthquakes, and would not be expected to cause damage to facilities or equipment.

Subsidence-related earthquakes associated with fluid withdrawal are well documented from the Wilmington oil field in Long Beach, California, where six events of magnitude **M** 2.4 to 3.3 occurred between 1947 and 1961 (Kovachs, 1974). The events reportedly occurred as a direct result of stresses induced by subsidence due to fluid extraction (Kovachs, 1974). The subsidence reached a maximum rate of 28 in/yr (71 cm/yr) in 1951. However, subsidence-related induced seismicity is not expected to occur within the project area or its vicinity as a result of mining the ore body because of the nature of the overburden materials and the depth of the ore body. Therefore, this impact would be adverse but not significant.

SURFACE RUPTURE. The potential for subsidence-related seismicity to result in surface rupture along the Pisgah Fault or Fault B is very low because potentially induced earthquakes, if any, are not expected to occur at magnitudes sufficient enough to generate surface displacement (generally magnitudes of M 6 or greater), and because subsidence, if any, is expected to occur over a relatively broad area and not to be sufficiently localized to create the stress necessary to result in surface rupture. Therefore, surface rupture in the project area is not anticipated and this impact is considered to be adverse but not significant.

MODIFICATION OF TOPOGRAPHY. During operation of the proposed action, minor alteration of topography would result from the construction of well-field drilling pads. This is considered an adverse, but not significant impact, due to the relatively small scale of the topographic alteration involved.

4.1.1.3 CLOSURE IMPACTS

Closure impacts include increased susceptibility to erosion due to the disturbance of surface soils as a result of closure activities. This impact would be adverse and potentially significant but, with mitigation, such as claiming disturbed areas, it would not be significant.

4.1.1.4 MITIGATION MEASURES

Mitigation for induced seismicity from injection is not considered to be necessary, as the potential for induced seismicity is expected to be low. However, if microearthquakes are induced by hydrofracturing of the ore body in the immediate vicinity of the well bottoms, reducing the injection pressures would mitigate this impact. In addition, construction techniques would be designed to withstand ground motions of non-project-induced seismic activity.

Impacts related to increased erosion may be mitigated by claiming disturbed areas to reduce the erosion potential.

4.1.2 HYDROLOGIC IMPACTS

4.1.2.1 CONSTRUCTION IMPACTS

Potential impacts to surface water during construction are related to minor alteration of the surface drainage patterns, which could result in flooding and erosion (see Section 4.1.1 for further discussion). Use of appropriate engineering practices during construction, however, can mitigate flooding and erosion hazards. This impact is considered adverse but, with mitigation, it is not significant.

Intermittent use of water for dust control and other construction-related activities would occur for short time periods and would have a minor effect on groundwater supplies. Because of the small magnitude of the effect, this impact is adverse but not significant.

4.1.2.2 OPERATION IMPACTS

Potential impacts during project operation are related to degradation of the subsurface ore zone formation water as a result of mining operations; drawdown and depletion of the aquifer in the supply wellfield area in the western portion of the project site; and degradation of groundwater or surface waters as a result of release of gypsum or other substances within the project area.

DEGRADATION OF ORE ZONE FORMATION WATER

Degradation of usable groundwater in water-bearing formations located adjacent to the block of mudstone comprising the central project area, due to infiltration of affected ore zone fluids, is not considered likely, due to (1) the impermeability of the mudstones surrounding the ore body and the apparent barriers to groundwater movement provided by the faults which bound the mudstone block, and (2) the neutralizing effect minerals in the formation would have on any acidic mining fluids which escape extraction. These two factors are discussed in the following sections.

GEOLOGIC CONTAINMENT

As described before, the mineralized zone is encapsulated within an envelope of evaporite mineral-bearing mudstone, which is in turn enclosed in mudstone (Section 3.1.2.5 and Figures 3.1-3 and 3.1-4). Permeability of the ore body, based on hydrologic testing, was very low and permeability of the surrounding claystone is expected to be even lower, on the order of a few millidarcies (Section 3.2.2.3). Examination of logs of core from the ore zone, obtained by FCMC as part of exploratory drilling, indicated the presence of almost no fracturing. Some distortion of bedding attitudes and possible fracturing and/or slippage was noted in one boring, DHB-34, at depths between 1,147 and 1,196 feet. This interval in the boring is above and laterally outside the ore body, as shown on Figure 3.1-4. There is no indication of significant faulting in this area, based on the FCMC boring logs. Similar instances of disturbed bedding, unrelated to faulting or large-scale fracturing, are common in gypsum/anhydrite-bearing formations, due to disturbance of bedding caused by volume change due to gypsum dewatering and conversion to anhydrite.

It is believed that the Pisgah fault west of the ore body area and Fault B, a second unnamed fault to the east, act as barriers to large-scale infiltration of formation waters into aquifers east and west of the central project area (Section 3.2.2).

The relatively impermeable and predominantly unfractured nature of the mudstone formation enclosing the ore body, and the apparent barriers to movement across the faults bounding the mudstone block containing the ore body, provide a high degree of containment for any process fluids from mining in the ore zone area which might escape extraction.

INORGANIC GEOCHEMICAL ANALYSIS OF MINING EFFECTS

The formation water in the mineralized project area (ore) zone is very saline with TDS concentrations ranging from approximately 23,000 to 30,000 mg/L (Table 3.2-1). This table also shows the analytical results of several water samples from two wells (SMT-1 and P-2), completed within the mineralized zone. As mentioned previously, the mineralized zone is primarily composed of anhydrite ($CaSO_4$), colemanite ($Ca_2B_60 \bullet 5H_20$), celestite ($SrS0_4$), calcite ($CaC0_3$) and clay minerals. Gypsum ($CaS04 \bullet 2H_20$) and howlite (a borosilicate mineral) are also present as secondary minerals.

High salinity of the formation water samples (Table 3.2-1) is probably due to dissolution of primary and secondary minerals. Therefore, the formation water and primary and secondary minerals are likely in equilibrium and the formation water should be saturated and/or supersaturated with these minerals. In order to investigate these probabilities, a geochemical computer model, PHREEQE, was used. PHREEQE is a well known and widely used computer model, originally developed by the USGS (Parkhurst et al., 1980). PHREEQE is a FORTRAN Computer program and is designed to model geochemical reactions in an aqueous medium. For this investigation, a microcomputer version of PHREEQE was used. This version was adapted by Lindberg (1986) from the VAX version in use at the University of Colorado, Department of Geological Sciences. The VAX version originated from Battelle P.N.L. where the original USGS version was modified to use the much larger MINTEQ database.

The program calculates reaction simulations based on the following input data: (1) pH; (2) Eh (oxidation/reduction state); and (3) total concentrations of various cations and anions detected in a water sample. Computer modeling was carried out for formation water samples (Table 3.2-1). Concentrations of major cations and anions, as well as pH data, were taken from Table 3.2-1 as input in PHREEQE. For Eh, a value of 0.01 volt was assumed. Eh variations should not have any major effect on dissolution of the primary and secondary minerals in the mineralized zone.

The results of computer modeling showed that all the formation water samples (Table 3.2-1) were supersaturated with respect to anhydrite, gypsum, calcite, and aragonite ($CaC0_3$). In addition, samples from SMT-1 (dated 3/81, Lab 2, and 4-4-81, Lab 1) and P-2 were supersaturated with respect to dolomite. The P-2 sample was also supersaturated with celestite. The PHREEQE program itself does not contain thermodynamic data for colemanite. Thus, the program could not calculate whether the formation water was saturated/supersaturated with respect to colemanite. However, due to the fact that the formation water is apparently in equilibrium with other minerals, it is reasonable to believe that the formation water is also in equilibrium with colemanite; i.e., the colemanite has been dissolved in formation water to saturation.

Anhydrite, gypsum, and probably colemanite are the most soluble minerals among the ore body primary and secondary minerals. Therefore, the TDS of the formation water should be determined primarily by dissolution of these minerals. Since the results of computer modeling indicate that the formation water is saturated/supersaturated with respect to gypsum and anhydrite (and probably colemanite), it is likely that the TDS values in Table 3.2-1 reflect the maximum TDS concentrations possible in the formation water.

As described previously, during the mining operation dilute acidic solutions of sulfuric and/or hydrochloric acid would be injected into the mineralized zone. Prior to injection, the acids in the solution dissociate as follows:

$$HCl \longrightarrow H^+ + Cl^- \tag{3}$$

$$H_2S0_4 \longrightarrow 2H^+ + S0^=_4 \tag{4}$$

Therefore, the injected solution contains relatively high concentrations of hydrogen, chlorine, and sulfate ions in a low pH solution. Mixing of the acidic mining solution with basic formation water (pH >8) triggers the following reactions that consume some of the H^+.

$$OH^- + H^+ \longrightarrow H_20 \tag{5}$$

$$HC0^-_3 + H^+ \longrightarrow H_20 + C0_2 \tag{6}$$

$$C0^=_3 + 2H^+ \longrightarrow H_20 + C0_2 \tag{7}$$

However, the pH of the mixture of formation water and injected acid solution would drop, as compared to the formation water, in the immediate vicinity of the injection point. The results of PHREEQE modeling indicated that the formation solution is in equilibrium with the minerals in the mineralized zones. The lower pH would result in disequilibrium and the mixture of formation water and injected mining solution would react with the in-situ minerals according to the following reactions:

$$Ca_2B_6011 + 7H_20 + 4\,H^+ \longrightarrow 6H_3B0_3 + 2Ca^{++} \tag{8}$$

$$CaC0_3 + 2H^+ \longrightarrow Ca^{++} + C0_2 + H_20 \tag{9}$$

$$CaMg\,(C0_3)_2 + 4H^+ \longrightarrow Ca^{++} + Mg^{++} + 2C0_2 + 2H_20 \tag{10}$$

Due to the abundance of colemanite and calcite, and to some extent dolomite, both within the ore body itself and in the surrounding envelope of evaporite-bearing mudstone (Section 3.1.2.5) there would be an ample amount of these minerals to neutralize the injected acidic mining solution. Most of the injected acidic mining solution would be expected to be neutralized in the immediate vicinity of the injection point. However, some of the solution would probably migrate to some distance from the point of injection. The migration distance, however, would be limited because the migrating solution would be neutralized either by reaction with the formation water or the neutralizing minerals that are present within the formation.

In addition to the above-mentioned neutralizing minerals, there are other minerals in the formation, such as clays, that are effective in neutralizing acids. Clay minerals can neutralize acids through exchanges between H^+ and cations on clay's exchange sites. A generalized chemical reaction can be written as follows:

$$M\text{-clay} + nH^+ \longrightarrow H^+\text{-clay} + M^{n+} \tag{11}$$

where

"M" represents various cations, mainly Na, K, Ca, Mg, Fe, Mn, etc.

The ore zone, as well as the surrounding evaporitic claystone and claystone, contain many neutralizing minerals, as discussed above. Therefore, it is highly unlikely that acidic solutions containing H^+ would escape a limited zone of injection without being neutralized within a short distance from the injection point.

In addition to containing a relatively high hydrogen ion concentration (i.e. a low pH solution) the injected mining solution also contains concentrations of anions including sulfate ($S0_4^=$) and chloride

(Cl). Thus, there is a possibility that introduction of these dissolved anions would increase the TDS of the formation water and potential migration of these compounds may adversely impact the groundwater resources in the area. Such possibility, however, is remote, as discussed below.

As previously discussed, as injection continues during the mining process, extraction of solutions would also take place. Therefore, most of the injected dissolved constituents, if not all, would be removed from the subsurface, decreasing the possibility of elevating TDS concentrations significantly. Extraction would also minimize the possibility of the mixture formation/injection fluid escaping from the mineralized zone. In addition, precipitation of sulfate minerals would likely take place which would help to decrease the TDS in formation solution. As discussed previously, when the acidic solutions react with neutralizing minerals, dissolved cations such as Ca^{++} and Mg^{++} would be released into the solution (see Equations 8, 9 and 10). The results of computer modeling (PHREEQE) indicated that the formation water is saturated/supersaturated with respect to several minerals, including anhydrite and gypsum. This means that the concentrations of Ca^{++} and $S0_4^=$ in the formation water, after injection of mining acid, would increase. Such increases coupled with the increase of sulfate in the formation water would cause a disequilibrium and result in precipitation of anhydrite and gypsum according to the following reactions:

$$Ca^{++} + S0_4^= \longrightarrow Ca\ S0_4 \text{ (anhydrite)} \qquad (12)$$

$$Ca^{++} + S0_4^= + 2\ H_20 \longrightarrow Ca\ S0_4 \cdot 2\ H_20 \text{ (gypsum)} \qquad (13)$$

The above reactions and resulting precipitation of anhydrite and gypsum would cause a considerable reduction in sulfate and calcium concentrations in the formation solution. Thus, it is expected that sulfate and calcium concentrations would stay at approximately the same level as present concentrations. The injection process, however, may result in a net increase in chloride concentration if hydrochloric acid is used on the constituents of injection solution. Chloride concentration is expected to rise because chloride-containing minerals are normally very soluble and do not readily precipitate. However, due to the fact that there would be an extraction that exceeds injection, net rise in chloride concentration may be negligible, if any. A potential increase in chloride concentrations may be eliminated by using a sulfuric acid solution only.

ORGANIC COMPONENT OF MINING SOLUTION

Mining solution is expected to contain a residue of isooctanol (isooctyl alcohol) from the solvent extraction process at concentrations of less than 300 ppm. Chemical analyses of the mining process solution (collected during pilot studies following the solvent removal process and prior to acid regeneration of the solution) indicated that kerosene was not detected in the solution at or above the laboratory detection limit of 10 milligrams per liter (parts per million). Isooctanol is a general term applied to any isomer of the formula $C_8H_{17}OH$. Isooctanol has a relatively low toxicity. The oral LD_{50} dose (the dose capable of killing 50 percent of the animals in a group) is 1,480 mg/kg in rats (Scala and Burtis, 1973). As described in the previous section, extraction of the mining process solution would remove most of the isooctanol from the ore zone. However, the possibility cannot be discounted that some of the process fluid would remain in the formation and migrate beyond the mining zone. Degradation rates for isooctanol are not available, but degradation rates for isopropanol (Isopropyl alcohol, C_3H_7OH) are expected to be similar to those for isooctanol. The anaerobic aqueous degradation half-life for isopropanol is reported to be in the range of 4 to 28 days, with an aerobic groundwater degradation half-life reportedly ranging from 1 to 14 days (Howard et al., 1991). (Isooctanol is degraded to carbon dioxide and water. The degradation half-life for a compound is defined as that period of time in which one-half of the compound would be degraded, i.e. no longer present.) Conservatively assuming a degradation half-life for isooctanol of 56 days (twice that for isopropanol), the concentration of isooctanol present at an initial concentration of 300 ppm would be reduced to less than 10 ppm in 280 days (less than 10 months). Given that the ore zone is very impermeable, migration times of any fugitive mining process fluid significantly beyond the mining zone would be expected to be quite slow, allowing ample time for degradation of the organic component to low levels before significant migration of the fluids, if any, has taken place.

EVALUATION OF MINING WATER QUALITY IMPACTS

The geochemical analysis of the projected effects of solution mining on ore zone formation water indicates that the only significant effect on the water outside the immediate zone of mining may be an increase in chloride and the possible addition of low concentrations of isooctanol. As described in the previous section, degradation rates for a similar alcohol suggest that isooctanol is relatively rapidly degraded even in anaerobic environments, and thus is expected to be degraded to very low concentrations before significant migration, if any, has taken place. However, the formation water in the ore zone area is not considered suitable for use as drinking, agricultural, or industrial water, due to the high concentration of TDS and other constituents. For this reason a potential increase in chloride or a temporary increase in isooctanol, as discussed above and in the previous section, is not considered to represent a significant impact. Further, a high degree of geologic containment of the formation water within the ore zone is believed to exist, as discussed above. For these reasons, degradation of water quality in water-bearing formations adjacent to the block of mudstone comprising the central project area, due to infiltration of mining process fluids, is not considered likely. Consequently, this potential impact is considered adverse but not significant.

EVALUATION OF GYPSUM STORAGE GROUNDWATER QUALITY IMPACTS

Gypsum and gypsum slurry will be stored in an unlined gypsum deposition area (Section 2.2.1.3). The gypsum is composed predominantly of calcium sulfate, and there is no evidence of the presence of hazardous constituents in the gypsum, including metals, as demonstrated by chemical analysis of gypsum produced during pilot studies.

While it is likely that some fluids saturated with calcium sulfate may percolate into the subsurface from the gypsum deposition area, the risk of any impact on groundwater at the site is very low, as the upper saturated zone is not only over 300 feet below the ground surface, but the gypsum deposition area is underlain by very low-permeability mudstones (Section 3.2.2.3), making it unlikely that surface gypsum would have any impact on underlying formation water. In addition, gypsum occurs naturally in the sediments immediately below the proposed gypsum deposition area location. Also, formation water is presently supersaturated with gypsum and saline, with no beneficial uses (Section 3.2.2.6).

CONSUMPTIVE USE OF GROUNDWATER

The hydrogeologic impact due to groundwater extraction at the site was estimated (1) in terms of estimated safe yield and (2) in terms of maximum water table drawdown as a result of constant pumping at an average rate of 100 gallons per minute (gpm), the approximate amount of groundwater required for project operations.

For estimation of maximum drawdown two scenarios were assumed: five wells pumping at the rate of 20 gpm, and one well pumping at an average rate of 100 gpm. As can be seen from equation (2) in Section 3.2.2.4, for the case of a constant rate of pumping, maximum drawdown occurs at the pumping well when the hydraulic conductivity value is at a minimum value and when the radius of influence is at a maximum value. In the following calculations the minimum hydraulic conductivity value of 1.6 feet/day and maximum radii of influence were used.

In the first scenario it was assumed that the five wells were located 1 mile apart. In this case the maximum radius of influence was approximately 2,000 feet (approximately 1/2 mile), resulting in a maximum drawdown of 7.3 feet at each well. In the second scenario, the maximum radius of influence was 12,500 feet (approximately 2-1/2 miles). In this case, the maximum drawdown at the pumping well was estimated to be 45.6 feet. These drawdown calculations were based on available data, and consequently there is a relatively high level of uncertainty associated with them, as discussed in Section 3.2.2.4.

The estimated safe yield of the aquifer in the area of the supply well network is estimated to be between 163 and 405 acre-feet annually. As noted in Section 3.2.2.4, there is a relatively high level of uncertainty associated with this estimate, which is based on available data. Planned consumptive groundwater use by the Rheox, Inc. facility would be approximately 14.6 acre-feet of groundwater per year. If Rheox, Inc. encounters any problems with pumping water from their wells, FCMC has agreed to provide Rheox, Inc. with water from FCMC wells. Consumptive groundwater use by the proposed action would be approximately 161 acre-feet annually. Total consumptive use is approximately 176 acre-feet annually.

Based on the above discussions, it appears that drawdown of the aquifer would occur locally and that the estimated safe yield of the aquifer may be exceeded. This impact is considered adverse, significant, and unmitigated.

DEGRADATION OF SURFACE WATER

The proposed action includes a holding area for gypsum that would be produced as a byproduct of the boric acid mining process. This area is sited in a low area between two low hills in the north-central project area, and would be bordered on the north and south by earthen containment dams. Subsurface soil sampling and testing will be conducted to confirm soil conditions in the gypsum holding area prior to construction of containment dams. The sides of the holding area dams would be covered with an impenetrable barrier material to prevent leaching of dissolved gypsum into surface water or soil. The gypsum would be kept continuously wet. It is possible that extremely heavy rains could cause overflow of the holding area, resulting in runoff of water and gypsum. This occurrence is considered an adverse but not significant impact because with proper engineering design of the holding area surface runoff is diverted from around the holding area, and by keeping the gypsum level well below the top of the containment dams, it can be avoided.

Other potential spillage at the site may include such things as process chemicals and oil and grease from project vehicles. Spillage of process chemicals is expected to be minimal, if any. Chemical storage would be within bermed spill containment areas with impermeable floors and sides. Other spills are expected to be minimal and execution of proper spill prevention and control measures would minimize the effects of potential spills on surface waters. Occurrence of such spills is considered an adverse but not significant impact because, with proper spill prevention and control measures, significant effects on surface waters can be avoided.

4.1.2.3 CLOSURE IMPACTS

Closure of the proposed facility would involve abandonment of the injection and extraction wells. It is likely that all the injected mining process solution would be removed from the ore zone at the end of mining, leaving some formation fluid in the subsurface that has been somewhat degraded. Because of the very low permeability of the mudstones surrounding the ore body, the presence of degraded formation water is not expected to significantly impact groundwater in surrounding areas, as discussed in Section 4.1.2.4. The impact of this occurrence could be minimized by pumping formation water from the extraction wells until formation waters with typical formation water pH (>8) are produced.

Impacts to groundwater during closure also would involve use of groundwater for various closure-related purposes, including dust control. This type of use would occur for short time periods and would have a minor effect on groundwater supplies. Because of the small magnitude of the effect this impact is considered adverse but not significant.

Potential impacts to surface water during closure are also related to alteration of the surface drainage patterns, which could result in flooding and erosion. Use of appropriate engineering practices during closure operations, however, can mitigate flooding and erosion hazards. This impact is considered adverse but, with mitigation, it is not significant.

4.1.2.4 MITIGATION MEASURES

SURFACE WATER

Potential impacts to surface water during construction, operation, and closure due to alteration of surface drainage patterns can be mitigated by implementation of proper engineering design to prevent flooding and erosion.

GROUNDWATER

Impacts to areas of usable groundwater due to migration of mining process solutions from the ore zone area are not expected to occur, as discussed in Section 3.2. However, the following measures would be implemented in order to provide additional assurance that such migration would not affect aquifers in adjacent groundwater basins:

- Additional monitoring of piezometric levels within the mining area and vicinity would be carried out and the hydraulic gradient in the ore zone area would be evaluated. Monitoring wells would be installed in a downgradient direction from the ore zone and monitored periodically to assess changes in formation water chemistry, if any, to evaluate any changes which may result from migration of mining process solution. In addition, samples from selected water supply wells adjacent to the Pisgah fault would be periodically analyzed for chemical changes, if any, which might indicate migration of mining process solutions from the mining area. If mining process solution constituents were detected, the RWQCB would be notified.

- Following completion of mining activities at the site, and as part of closure, extraction wells would be pumped to remove formation fluids until low-pH fluids have been removed and fluids of normal pH are produced. This would remove most of the affected formation water from the ore zone area. As discussed in Section 3.2, residual affected fluids remaining in the formation would be neutralized by evaporite and clay minerals in the formation, resulting in lowering of the pH and precipitation of minerals from the solution as pH is lowered, bringing the TDS into a range close to normal for the formation. The isooctanol component of the mining process fluid is believed to degrade relatively rapidly in the subsurface, as discussed in Section 4.1.2.2, and thus the isooctanol in any solution remaining in the formation would be degraded.

- Recycled water would provide the opportunity for a reduction of total water consumption during operational activities. Options would include:
    - Recycling free-standing water in the gypsum settling pond (approximately 20-40 gpm);
    - Use of recycled water from the cooling tower in the heat exchanger; and
    - Maintaining optimal systems operation to reduce the amount of water required to less than 100 gpm.

4.1.3 AIR QUALITY

4.1.3.1 CONSTRUCTION IMPACTS

The construction phase of the project is anticipated to occur over a nine-month period. The first phase of construction would involve the construction of the process facility building, access roads, and security fences. Construction of the natural gas pipeline, the transmission line, and the rail spur would occur following the completion of the access roads and process facility. Construction of the well field will occur throughout the construction phase.

Site preparation work for all facilities would involve clearing and grading. Mobile equipment expected to be used during the construction phase includes two graders, two loaders, and four haul trucks.

Typical emissions from construction activities include combustion emissions from heavy-duty construction equipment and fugitive dust emissions from earthmoving activities and vehicular travel over dirt and gravel roads. Fugitive dust emissions can be effectively controlled using either water application or chemical suppressants and/or revegetation.

Construction of the gypsum deposition area would occur over a one-month period and involve approximately ten workers. Construction activities would involve excavation of a retention basin and the erection of containment dams around the basin. The bottom of the retention basin will not be lined, but the sides of the containment dam will be lined to contain the gypsum slurry.

The well-drilling operation would be initiated during the construction phase. Approximately 250 wells are anticipated to be drilled during the first nine months, with an estimated ten replacement wells drilled each year. This represents an intermittent source of emissions during the year.

Equipment anticipated to be used during the drilling of each well includes one drill rig, one backhoe, one 3,000-gallon water truck, one or two pickup trucks for tool and personnel transportation, and about three delivery vehicles per week.

The drilling program is expected to involve a total of up to seven drilling units operating simultaneously, each operated by a three-person drilling crew.

Up to seven process water supply wells would be constructed along with the 250 injection/extraction wells. As process water supply wells are depleted, new wells would periodically be drilled. Equipment associated with construction of the water wells is anticipated to be similar to the well drilling activities described above. Combustion emissions generated during typical well drilling activities include SO_2, NO_x, CO, ROG, and exhaust particulates. These emissions are expected to be short-term in duration and would substantially decrease when the operation phase of the project commences. Combustion emissions from drilling operations would contribute approximately 70 lbs/day of NO_x, 20 lbs/day of CO, and less than five lbs/day of PM_{10}, SO_2, and ROG.

The emissions associated with the above activities would be short-term and are not expected to violate ambient air quality standards or San Bernardino County New Source Review emission thresholds. Therefore, the emissions during construction activities are expected to be adverse but not significant.

4.1.3.2 OPERATION IMPACTS

The proposed process consists of five stationary emission sources which include the cogeneration plant, the solvent extraction facility, the purification/crystallization facility, the acid regeneration and injection facility, and the product loading and shipping facility.

A basic process description for each of the project components is provided in Section 2.0 of this document. A brief summary of emission points is presented below, followed by a summary of air quality impacts. A summary of stationary source emissions is provided in Table 4.1.3-1. The emission values presented in Table 4.1.3-1 correspond with the values included in the Revised Application for the Permit to Construct submitted to the APCD.

COGENERATION PLANT

The cogeneration plant would provide both power and steam for various operations within the facility. The bulk of the electrical power required for the facility is supplied by a 4.1-MW natural gas-fired turbine generator. The Southern California Edison electrical grid will supply additional power, if necessary. Process heat is generated from a 49-MMBTU/hr waste heat recovery boiler which utilizes the turbine exhaust gases. A 4-MMBTU/hr duct burner supplements the waste heat boiler while combusting organic vapors from the solvent extraction facility.

TABLE 4.1.3-1
STATIONARY SOURCE EMISSIONS SUMMARY

STACK INFORMATION							POLLUTANT EMITTED (lb/hr)						
Pt ID	Description	Effic, %	Hht,ft	Temp, F	Q, cfm	Vel, fpm	UH	VOC	CO	NOx	Part	SOx	Other
Permit Units													
E7	Filter Vacuum Pumps (2)			110	4900	1145	--	--	--	--	--	--	H2O = 1,142.92
E10	Cogeneration Facility (4.1 MW)* (gas-fired turbine and waste heat boiler) with supplemental firing (4 MMBTU/hr) *		80	500	145545	3700	3.410	0.341	5.95	4.90	0.053	negl	H2O = 4,687.00
					lb/hr								CO2 = 5,724.00
							0.100	0.032	0.20	0.36	0.020	negl	N2 = 27,556.00
E11	Cooling Tower			106	248500	1450	--	--	--	--	negl	--	H2O = 14,375.00
E12	Product Dryer Baghouse *	**		149	41500	3760	0.275	0.088	0.55	0.99	<2.134 **	negl	H2O = 3,587.00
	(11 MMBTU/hr)												CO2 = 1,394.00
													N2 = 6,712.00
E14	Storage Area Baghouse	**		149	11000	2870	--	--	--	--	<0.566 **	--	
E15	Bulk Loading Station Baghouse	**		110	750	2150	--	--	--	--	<0.039 **	--	
E16	Bagging Area Baghouse	**		110	750	2150	--	--	--	--	<0.039 **	--	
Fugitive Emissions													
	HCL Tank Absorption Tube										negl***		
	H2SO4 Tank Absorption Tube										negl***		
	Lime Storage Displacement Filter			110	720	3670	--	--	--	--	<0.009 **	--	--
	Gypsum Storage Area			120			--	--	--	--	negl	--	H2O=0.06 lb/hr/ft2
					Totals (lb/hr)		3.785	0.461	6.70	6.25	2.859		
					Totals (lb/day)		90.84	11.06	160.80	150.00	68.63		
					Totals (ton/yr)		16.58	2.02	29.35	27.38	12.52		

* VOCs would be less than 10% of total UH (AP 42). All emission factors were vendor supplied.

** An exit PM10 emission rate of 0.006 grains/dscfm will be attained utilizing BACT.

*** Includes HCL and H2SO4.

MW - Denotes one million watts.

MMBTU - Denotes one million BTU's.

Emissions based on 24 hr/day and 365 day/yr.

The cogeneration facility is likely to represent the major contribution of NO_x emissions from the project. Emissions released would also include lesser quantities of CO, ROG, and SO^2.

SOLVENT EXTRACTION FACILITY

The boron-rich solution extracted from the wells is routed to the solvent extraction facility, where the recovered boron is concentrated. The solvent extraction facility includes cooling equipment, filters, surge tanks, pH control equipment, and solvent mixers and settlers.

In this process, the boron-rich solution is cooled and mixed with an organic solvent, a mixture of isooctanol and kerosene. The boron is then removed from the organic solvent using a weak acid solution and the concentrated boric acid solution is routed to the purification/crystallization and product loading facilities.

The spent well-field solution is routed to the acid regeneration and injection facility to be regenerated and reinjected into the well field for further boron recovery.

Organic emissions from the solvent extraction facility that may occur as the boron-rich solution is mixed with the isooctanol and kerosene solvents will be routed to the duct burner and waste heat boiler for incineration. Small quantities of ROG fugitive emissions may occur from piping, valves, or flanges which carry the solvent. Submersible pumps will be used for the extraction process. Therefore, no combustion emissions associated with these pumps would result.

PURIFICATION/CRYSTALLIZATION FACILITY

The purification/crystallization facility consists of dissolution tanks, filtering equipment, and crystallizing equipment. During this process, other particulate matter is removed by filtration and the boric acid is crystallized, resulting in a pure product of boric acid crystals. The other particulate matter removed in the filtration process is conveyed to the acid regeneration circuit to be reinjected, and the boric acid crystals are conveyed to the product drying and shipping section.

ACID REGENERATION AND INJECTION FACILITY

This facility consists of mixing tanks, lime pH control equipment, acid surge tanks, acid pumps, filters, slurry advance pumps, and injection pumps. An estimated 9,400 tons of hydrochloric acid and 50,000 tons of sulfuric acid are expected to be used at the facility each year. Each acid will be stored in two dedicated on-site storage tanks.

In the regeneration process, the calcium chloride-rich solution is pumped into mix tanks where the solution is agitated and mixed with an excess of sulfuric acid. The calcium chloride will react with the sulfuric acid and form hydrochloric acid and gypsum (calcium sulfate). When the acid solution is at a sufficient strength, it is re-injected into the ore body by use of injection pumps.

Each of the dedicated acid storage tanks will have an absorption tube vent insert to abate any acid mist generated during tank loading. The dry bulk lime storage silo will have a displacement filter for its loading abatement system.

The gypsum holding area represents a potential source of particulate emissions. The surface of the area, however, is expected to remain continuously wet from the on-going deposition of newly-formed gypsum, so potential emissions are expected to be minor.

PRODUCT LOADING AND SHIPPING FACILITY

The product loading and shipping facility would consist of a centrifuge, an 11 MMBTU/hr natural gas-fired product dryer, various product screens, storage bins, bulk loading and bagging equipment, and baghouse dust collecting systems. Primary emissions associated with this facility would be combustion emissions from the product dryer and particulate emissions from the dry product handling facilities.

All locations that are capable of generating dust emissions would be controlled by high-efficiency baghouse designed to meet emission specifications of the vendor as required or mandated by the San Bernardino County Air Pollution Control District (SBCAPCD). An ongoing maintenance program would provide the proper operation of the baghouses.

MOBILE SOURCES

Mobile sources would constitute an ongoing source of NO_x (123.0 lb/dy), ROG (99.76 lb/dy), CO (99.7 lb/day), and particulates 1.2 as PM_{10}), throughout the operation of the project. Emissions would be generated by material delivery vehicles, rail operations, and employee vehicles. There are anticipated to be approximately 3 railcar trips, 28 truck deliveries, and approximately 130 motor vehicle trips generated per day. Some incremental increase in NO_x is expected due to mobile source emissions. The majority of facility employees are assumed to commute from Barstow, Newberry Springs, and Ludlow.

ROADS

The unpaved access roads on the property would be a potential source of PM_{10} emissions. Estimated PM_{10} emissions are 338.2 lb/day.

IMPACT SUMMARY

Principal emission sources associated with the proposed action include combustion emissions from the cogeneration facility, product dryer, and motor vehicles and fugitive dust emissions from dry product handling equipment and unpaved roads. Emissions from these sources present a potentially significant but mitigatable impact to air quality. The proposed project would be constructed and operated in an EPA classified "nonattainment area" for ozone and particulate matter. Mitigation measures are proposed (see Section 4.1.3.4) that are expected to reduce criteria emissions to a not-significant level. The APCD has reviewed the air permit application for the project and has issued draft permits.

4.1.3.3 CLOSURE IMPACTS

Air quality impacts during closure would be similar to construction impacts, but their magnitude would be substantially less. Therefore, as with construction, no significant impacts on ambient air quality are expected.

4.1.3.4 MITIGATION MEASURES

MITIGATION OF CONSTRUCTION EMISSIONS IMPACTS (SHORT-TERM)

1. Construction operations shall be curtailed during periods of high winds (i.e., 10 m/sec).

2. Exposed, disturbed surfaces shall be watered and/or revegetated as soon as practical to prevent wind-blown dust.

3. Vehicular dust generation on access roads shall be minimized by applying water or approved dust pallatives to all unpaved roads.

4. A speed limit of 15 miles per hour shall be posted and enforced on all unpaved roads.

5. The contractor shall establish physical barriers to define the construction site and limit unnecessary disturbance beyond the actual construction zone.

6. Construction equipment shall be maintained as per manufacturer's specifications.

MITIGATION OF OPERATIONAL EMISSIONS IMPACTS (LONG-TERM)

1. The operator shall implement an inspection and maintenance program to reduce fugitive emissions from organic solvent handling equipment (i.e., valves, flanges, and pumps).

2. The operator shall implement a ridesharing program to reduce commuter vehicle trips.

3. Optimal combustion conditions shall be maintained on driers and the concentration facility in order to reduce emissions of air pollutants.

4. The baghouse dust collection system, used for PM_{10} removal, shall be inspected, cleaned, and maintained regularly to promote maximum removal efficiency approaching system design levels.

5. The acid absorption system, shall be inspected, cleaned, and maintained regularly to promote maximum removal efficiency approaching system design levels.

6. Vehicular dust generation on access roads shall be minimized by applying water or approved dust pallatives to all unpaved roads.

7. After the Project is under operation, FCMC shall evaluate the feasibility of paving the main access road.

4.1.4 NOISE

4.1.4.1 CONSTRUCTION IMPACTS

Project construction would increase noise levels at and near the project site. Noise levels generated from earthmoving, grading, and other construction-related activities are expected to be relatively loud. However, due to the background noise present in the project area (I-40 and the Rheox, Inc. Hector Mine), the short-term nature of the activity, and the absence of sensitive noise receptors in the vicinity of the project site, construction noise is expected to be an adverse but not significant impact.

4.1.4.2 OPERATION IMPACTS

During the operational phase, noise associated with the project site would be generated by intermittent drilling of new injection wells into the ore body, the processing facility, employee traffic, and truck and train traffic to and from the proposed facility.

Drilling of new injection wells would begin during the construction phase. This would continue through the operational phase to develop wells needed to maintain production. Drilling operations would add substantially to the average daily noise level.

Operation of the processing facilities would take place inside the process plant building. This would reduce the external noise levels.

Employee traffic is estimated at 130 vehicle trips per day. The final product would be transported from the project site via train and truck. Railcars would be attached as needed to the current two trains running per day which would run to the site via the new rail spur. Approximately 28 truck trips would be anticipated daily. Increases in noise levels resulting from these types of traffic would occur intermittently throughout a 24-hour period.

Based on the discussion above, there would be a substantial increase in noise levels during the operational phase. However, since there is an absence of noise-sensitive receptors in the vicinity of the project, the Hector Mine already contributes to noise levels in the area, and train and vehicular traffic noises currently exist in the area, the noise increase during the operational phase of the proposed action is expected to be an adverse but not significant impact.

4.1.4.3 CLOSURE IMPACTS

Closure of the project site would generate noise levels similar to those generated during construction. For the same reasons discussed above in Section 4.1.4.1, increased noise levels during closure are expected to result in an adverse but not significant impact.

4.1.4.4 MITIGATION

No mitigation measures are necessary.

4.1.5 BIOLOGICAL RESOURCES

4.1.5.1 CONSTRUCTION IMPACTS

BOTANICAL RESOURCES:

Construction activities associated with the proposed action would lead to the following impacts to botanical resources:

- The removal of vegetation at facility sites and access roads, including the permanent loss of an estimated 356 acres of desert habitat and the temporary loss of four acres of desert habitat. Four acres is the estimated amount of land that would quickly regenerate, e.g., roadsides. Due to the large amount of creosote bush scrub in the area, the conversion of this land to developed uses is considered an adverse but not significant impact to botanical resources.

- The establishment of undesirable weedy vegetation, which may result in adverse, potentially significant impacts on sensitive species by increasing competition for limited habitat and soil moisture. With implementation of appropriate mitigation measures (see Section 4.1.5.4), this impact would not be significant.

- The compaction of soil, which could lead to difficulty in re-establishment of native plant species. This impact would be considered adverse and potentially significant; however, with implementation of appropriate mitigation measures (see Section 4.1.5.4), this impact would not be significant.

- The removal of individuals or small populations of sensitive plant species. No State or Federally-listed plant species are expected to be affected. Small populations of Crucifixion thorn and Utah Cynanchum (both listed by the CNPS; see Table 3.5-3) exist in the Project area; however, these populations exist only outside site areas proposed for development. Neither species is expected to be disturbed by construction of the Proposed Project. No other sensitive plant species are expected to be affected.

WILDLIFE RESOURCES — GENERAL WILDLIFE:

Construction activities associated with the proposed action could lead to the following impacts to wildlife resources:

- The loss or displacement of individual animals. Resident wildlife and bird species in the project area could be affected to varying degrees during construction of the proposed action. More mobile species (birds and large mammals) would be likely to emigrate; however, less mobile species (some rodents and reptiles) could be lost during earth clearing and pipeline construction. The loss of individual animals from species that have a widespread distribution throughout the desert would be considered an adverse but not significant impact.

- The loss of habitat and habitat features, such as cover and forage. Foraging areas and travel corridors for predators, such as foxes, coyotes, and raptors, would be eliminated by construction. While there would be a potential loss of wildlife denning, nesting, and feeding sites, a large amount of undisturbed habitat adjacent to the project site would remain undisturbed. Avian species are not expected to be affected by a loss of habitat because of their high mobility and the availability of similar adjacent habitat. The loss of habitat of species that have a widespread distribution throughout the desert would be considered an adverse but not significant impact.

  Disturbance in the water well field area should be minimal for most species, since only drilling pads and access roads would be cleared. Once construction is completed, human activity in the water well field would be limited and some species (i.e., rodents and birds) are expected to return to the area. Therefore, the loss of habitat in this area would be an adverse but not significant impact to wildlife resources.

  Construction activity could result in indirect degradation of habitat due to soil disturbance, increased levels of noise, traffic, equipment movement, fluid leakage, dust, and human presence. Additional clearance along access roads is anticipated to allow vehicles to pass each other. The degradation of habitat of species that have a widespread distribution throughout the desert would be considered an adverse but not significant impact.

There is a possibility of a pipeline rupture and discharge from a number of different pipelines associated with the Project, all critical to the mining operation. The pipelines are subject to periodic physical inspections and the pressure in the lines will be continually monitored so that a discharge would be quickly identified, operations discontinued, and the integrity of the line rapidly restored. A discharge, therefore, would be of short duration and minimal solution loss. Given the arid nature of the Project area, it is anticipated that the solution would be quickly absorbed into the soil. A water or gypsum/water slurry discharge would be considered a beneficial impact. A discharge of an acidic solution should be neutralized and/or removed to an approved disposal site.

WILDLIFE RESOURCES — SENSITIVE SPECIES:

The desert tortoise, State and Federally-listed, is the sensitive species most likely to be adversely affected by construction. Other sensitive species, such as the desert kit fox, the peregrine falcon, the prairie falcon, LeConte's thrasher, the chuckwalla, the California leaf-nosed bat, and the spotted bat are not expected to be significantly affected by construction activities, since these animals are highly mobile.

Construction activities associated with the proposed action could, however, lead to the following impacts to the desert tortoise:

- The loss of individual tortoises crushed by vehicles and construction equipment. This could occur when tortoises are either above-ground (e.g., along access roads) or when tortoises are inside their burrows. This impact would be considered adverse and potentially significant; however, with implementation of appropriate mitigation measures (see Section 4.1.5.4), this impact would not be significant.

  Increased human presence in the project area could also lead to the loss of individual desert tortoises. Illegal collecting, shooting, and vandalism, as well as habitat disturbance and loss of tortoises due to off-road vehicle activity could result from increased access and activity in the area. The loss of tortoises as a result of these activities would be considered adverse and potentially significant, however, with implementation of appropriate mitigation measures (see Section 4.1.5.4), this impact would not be significant.

- The removal of 341 acres of tortoise habitat features such as cover, forage, and established burrows. This impact would be considered adverse and potentially significant. However, with implementation of appropriate mitigation measures (see Section 4.1.5.4), this impact would not be significant.

- The fragmentation of desert tortoise habitat. Barriers to tortoise movement could be presented by access roads and above-ground pipelines, resulting in desert tortoise habitat fragmentation. Juvenile or sub-adult tortoises may be unable to cross, and even large adult tortoises could have difficulty crossing above-ground pipelines. This impact would be considered adverse and potentially significant; however, with implementation of appropriate mitigation measures (see Section 4.1.5.4), this impact would not be significant.

PROPOSED AREA OF CRITICAL ENVIRONMENTAL CONCERN

Potential significant adverse impacts to the area include the loss or disturbance of research study sites or areas that may have educational value within the BLM proposed Area of Critical Environmental Concern (ACEC). This would represent an adverse, potentially significant impact. Additional mitigation measures may be identified during the ACEC management planning process if the ACEC is designated.

4.1.5.2 OPERATION IMPACTS

Activities during operation of the proposed action would lead to the following impacts to biological resources:

- An increase in nighttime insect prey in the area. The California leaf-nosed bat, the spotted bat, and nocturnal insect-hunting birds may benefit from the night lighting and consequent increased supply of insects in the project area. This impact is considered beneficial.

- Degradation of habitat (including desert tortoise habitat) due to soil disturbance, increased levels of noise, traffic, equipment movement, fluid leakage, dust, and human presence. This would occur over time, allowing for plant and animal acclimation to the new habitat conditions. Therefore, the resulting impact would be considered adverse but not significant.

- The creation of ponded water in the southern edge of the gypsum deposition area. Biologists from the California Fish and Game and the Division of Aquatic Toxicology (M. Giusti, 1992; J. Harrington, 1992) did not anticipate any adverse impacts to wildlife resulting from the ingestion of this water. This opinion was confirmed by the Nevada Department of Wildlife, which stated that wildlife mortality was not a problem associated with a settling pond located at a gypsum mine in southern Nevada, although the mine has been in operation for several decades (Hardenbrook, 1992).

  The possibility of wildlife entrapment and drowning is largely dependent on the structure and configuration of the area of water collection. Many wildlife species, particularly small mammals and reptiles, could be attracted to the water and become trapped if the sides are steeply constructed. Many animals and reptiles could readily traverse the tortoise-proof fence.

  Given that wildlife species are known to utilize man-made water sources, the availability of a relatively high-quality water source resulting from the operation at the gypsum deposition area is considered to be a positive impact to wildlife.

  As gypsum is known to be virtually inert and insoluble in water, neither the gypsum nor colloidal gypsum/water slurry presents a recognized hazard to wildlife. It has been suggested that a possibly physical hazard may exist in the form of wildlife entrapment. Discussions with existing gypsum operations (Ordway, 1992) and empirical evidence suggest that risk is also negligible. However, in order to dismiss this question, the gypsum deposition area shall be inspected on a regular basis. This will allow the determination needed to ascertain what, if any, hazards may be presented to waterfowl from the fluids retained in the gypsum deposition area. The inspection of the gypsum deposition area can be completed in conjunction with inspections of the desert tortoise-proof fencing that will border the area. While ensuring the integrity of the fence, the ponds may be visually inspected for evidence of wildlife mortality. The attached Wildlife Mortality Form, adapted from the Nevada Department of wildlife's Mining Operations Wildlife Mortality Form, shall be completed, compiled, and sent to a designated contact at the Bureau of Land Management on a quarterly basis. If, at the end of one year of operation, wildlife mortality is negligible or absent, the inspections could be discontinued. If, however, chronic wildlife mortality is observed, the BLM shall be consulted to determine appropriate measures.

See Section 2.2.1.3 for a description of the gypsum deposition area.

4.1.5.3 CLOSURE IMPACTS

Biological resources impacts during closure would be similar to construction impacts, but their magnitude would be substantially less. Therefore, impacts to biological resources resulting from the closure of the proposed action would be adverse, but not significant.

4.1.5.4 MITIGATION

The proposed action is expected to have only minor effects on the biological resources of the area. However, some potentially significant adverse impacts to biological resources are expected to result from the construction of the proposed action. To reduce the significance of these potential impacts, the following mitigation measures are recommended:

GENERAL MITIGATION:

- The mine operator shall designate a field contact representative (FCR) who shall be responsible for overseeing compliance with protective stipulations for the desert tortoise and for coordination on compliance with the BLM and the U.S. Fish and Wildlife Service. The FCR shall have the authority to halt all mining activities that are in violation of the stipulations. The FCR may be the mine operator, the mine manager, any other mine employee, or a contracted biologist.

- At least 30 days prior to construction activities, a survey shall be conducted by qualified biologists to identify sensitive species and record their location. Special attention should be given to small burrows, cracks, and crevices in lava flows in order to locate and avoid chuckwallas, if feasible.

- When maintenance activities occur outside of areas enclosed by desert tortoise-proof fences, work areas shall be surveyed by the authorized biologist prior to the onset of maintenance to determine whether desert tortoises are present. If desert tortoises are present, the appropriate terms and conditions of the Biological Opinion shall be implemented to avoid take. All trenches, holes, or other hazards to desert tortoises shall be surrounded by desert tortoise-proof fencing or eliminated as hazards prior to the workers leaving the site. Alternatively, if fence construction is not feasible, the authorized biologist shall be present at all times that hazards to desert tortoises exist.

- An employee education program must be received, reviewed, and approved by the BLM at least 15 days prior to the presentation of the program. The program may consist of a class or video presented by a qualified biologist (BLM or contracted). Wallet-size cards with important information for workers to carry are recommended. All mine employees and contractors shall participate in the desert tortoise education program prior to initiation of mining activities. The operator shall be responsible for ensuring that the education program is developed and presented prior to conducting activities. New employees shall receive formal, approved training prior to working on-site. The program shall cover the following topics, at a minimum:
  - distribution of the desert tortoise,
  - general behavior and ecology of the desert tortoise,
  - sensitivity to human activities,
  - legal protection,
  - penalties for violations of State or federal laws,
  - reporting requirements, and
  - project protective mitigation measures.

- No on-site collection or killing of sensitive plant or wildlife species shall be permitted. Sensitive wildlife species found in the construction zone shall be removed by a qualified biologist. These animals shall be released in adjacent areas of similar habitat. Sensitive plant species shall be transplanted to a suitable nearby habitat under the direction of a botanist.

- Travel shall be limited to approved access roads and off-road use prohibited. A speed limit of 20 miles per hour shall be maintained by all employees and contractors of FCMC on all project roads that are not protected by desert tortoise-proof fencing.

- If desert tortoise-proof fencing is not constructed along the water pipeline, all project-associated vehicles shall maintain a speed limit of 20 miles per hour on this access road. The water pipeline shall be either buried or elevated for at least 100 feet every 1/4 to 1/2 mile to allow for the passage of desert tortoises. If the pipeline is elevated, the BLM shall ensure that the height of elevation will allow for the free passage of the largest possible desert tortoise.

- When outside of areas enclosed by desert tortoise-proof fences, workers shall inspect underneath any parked vehicles immediately prior to moving the vehicles. If a desert tortoise is beneath the vehicle, the authorized biologist shall be contacted to move the desert tortoise from harm's way. Alternatively, the vehicle shall not be moved until the desert tortoise has left of its own accord. The authorized biologist shall be responsible for taking appropriate measures to ensure that any desert tortoise moved in this manner is not exposed to temperature extremes which could be harmful to the animal.

- The area of disturbance shall be confined to the smallest practical area, considering topography, placement of facilities, location of burrows, public health and safety, and other limiting factors. Work area boundaries shall be delimited with flagging or other marking to minimize surface disturbance associated with vehicle straying. Special habitat features, such as burrows, identified by the qualified biologist shall be avoided to the extent possible. To the extent possible, previously disturbed areas within the mining site shall be utilized for the stockpiling of excavated materials, storage of equipment, digging of slurry and burrow pits, location of office trailers, and parking of vehicles. The qualified biologist, in consultation with the project proponent, shall ensure compliance with this measure. Construction equipment and access roads shall be monitored by qualified biologists. Incidents of non-compliance with established regulations shall be reported by the biologists to construction management and agency enforcement personnel.

- A trash abatement program shall be developed and implemented. All trash and food items shall be promptly contained within raven-proof containers. These shall be regularly removed from the project site to reduce the attractiveness of the area to common ravens and other desert tortoise predators. No fires shall be allowed on site.

- Structures that may function as common raven nesting or perching sites shall not be authorized except as specifically stated by the BLM. The project proponent shall describe anticipated structures to the BLM during initial project review.

- Hazardous material spills, including spills of oils, coolants, grease, diesel fuel, and gasoline shall be cleaned up immediately and the hazardous materials removed, except at designated maintenance yards and containment areas, which shall be cleaned at the end of the project.

Equipment from which fluids are leaking would be repaired immediately. Hazardous materials accumulated through routine maintenance shall be disposed of properly at an approved facility.

- The contractor shall be held responsible for post-construction clean-up. Excess materials and litter generated during construction shall be removed. Following completion of construction, barriers shall be erected to limit traffic to the main access roads.

- A final inspection shall be conducted to evaluate additional impacts to desert habitat. No later than 90 days after completion of construction activities, the FCR and authorized biologist shall prepare a report for the BLM. The report shall document the effectiveness and practicality of the mitigation measures, the number of desert tortoises excavated from burrows, the number of desert tortoises moved from the site, the number of desert tortoises killed or injured, and specific information for each desert tortoise, such as location, general health and condition, location the animal is moved to and from, and specific diagnostic markings. The report shall make recommendations for modifying the stipulations to enhance desert tortoise protection or to make it more workable for the operator. The report shall provide an estimate of the actual acreage disturbed by various aspects of the operation.

- Animals and birds shall be prevented from ingesting acid solution resulting from spill areas by promptly neutralizing and cleaning up spills. Acid solution in containment areas is collected and pumped back to surge tanks using pumps equipped with automatic float switches.

- An attempt shall be made to contact the individuals or institutions conducting research in or near the project area to alert them of the potential impacts to wildlife and change in land use. In addition, above-ground pipelines that traverse research areas shall include measures to allow wildlife passage. Possibilities include periodically burying portions of the line, incorporation of earthen ramps, and elevating the pipeline one foot above the ground for at least 100 feet every 1/4 to 1/2 mile to allow for the passage of desert tortoises. This would reduce impacts to wildlife mobility and habitat fragmentation, and allow research on wildlife to continue in the area. The one-foot height is too low to be considered a suitable raven perch and would allow adequate passage for wildlife.

- The sides of the gypsum deposition area shall be gently sloped so as to reduce the possibility of entrapment or drowning.

ADDITIONAL, SPECIES-SPECIFIC MITIGATION:

Desert Tortoise

- If FCMC fails to comply with any of the reasonable and prudent measures or terms and conditions of the USFWS Biological Opinion, the BLM shall suspend the right-of-way permit for the public lands until such time that FCMC is in compliance with these terms and conditions. The BLM shall also notify FCMC at that time that failure to comply will lead to revocation of the right-of-way permit.

- If feasible, construction shall take place during periods when tortoises are least active; i.e., during the tortoise hibernation or estivation periods (approximately between June 15 to September 1 and November to March 1) to limit desert tortoise fatality.

- Only biologists authorized by the USFWS and the BLM shall handle desert tortoises. The mine operator shall submit the name(s) of the proposed authorized biologist(s) to the USFWS for review and approval at least 15 days prior to the onset of activities. No mining activities shall begin until an authorized biologist is approved.

- The authorized biologist shall be required on-site during pre-construction and construction activities which could harm desert tortoises. This biologist shall have authority from the operator to halt any action that might result in harm to a desert tortoise.

- The authorized biologist shall maintain a record of all desert tortoises encountered during mining activities. This information shall include for each desert tortoise:

  1. The locations (narrative and maps) and dates of observation;
  2. general condition and health, including injuries and state of healing and whether animals voided their bladders;
  3. location moved from the location moved to; and
  4. diagnostic markings (i.e., identification numbers or marked lateral scutes).

- Construction sites shall be surveyed 30 days, 72 hours, and again immediately prior to the commencement of construction activities. Tortoises found in burrows shall be relocated no more than 300-1000 feet from the original burrow. These tortoises shall be placed in existing unoccupied natural burrows, if possible, but if such burrows cannot be found, artificial burrows of approximately the same size, shape, and orientation shall be constructed. Tortoises found above-ground shall be moved just prior to construction to decrease the possibility of the animals returning to the construction zone.

  Desert tortoises may be handled only by the authorized biologist and only when necessary. *New* latex gloves shall be used when handling each desert tortoise to avoid the transfer of infectious diseases between animals. In general, desert tortoises shall be moved the minimum distance possible to ensure their safety. The authorized biologist(s) shall follow the general handling methods contained in the "Protocols for Handling Live Tortoises" (Arizona Game and Fish Department, et al., 1991). The USFWS Biological Opinion (Appendix C) does not authorize replacement of lost fluids in any desert tortoise with a syringe or the drawing of blood. Only qualified biologists shall handle tortoises, and accepted protocol for the marking and displacement of tortoises shall be followed (Interim Techniques Handbook for Collecting and Analyzing Data on Desert Tortoise Populations and Habitats, Chapter III, 1990).

- The authorized biologist shall instruct appropriate mine employees, such as environmental compliance personnel or project managers, in the proper method of handling desert tortoises in the event of emergencies involving animals during routine operation of the facility. Alternatively, the FCMC shall retain a local biologist, to be authorized by the U.S. Fish and Wildlife Service and the BLM, who would be available on short notice in the event of an emergency. All desert tortoises handled under emergency circumstances shall be reported to the U.S. Fish and Wildlife Service and the BLM immediately and the information, such as location, general health and condition, location the animal is moved from and to, and diagnostic markings.

- All project facilities, including any borrow pits, shall be enclosed within desert tortoise-proof fences. The fences shall be constructed under the direction of the authorized biologist or a BLM compliance technician. The fences shall be located to avoid all desert tortoise burrows; to the extent possible, burrows shall be placed on the outside of the enclosures. The fences shall be constructed of 1/2-inch mesh hardware cloth. They shall extend 18 inches above ground and 12 inches below ground. Where burial of the fences is not possible, the lower 12 inches shall be folded outward against the ground and fastened to the ground so as to prevent entry by desert tortoises. The fences shall be supported sufficiently to maintain their integrity. The fences shall be checked at least monthly and maintained when necessary by the mine operator to ensure their integrity. All desert tortoise-proof fencing should be removed after site rehabilitation.

- After fence installation, the authorized biologist shall conduct a thorough survey for desert tortoises within all enclosed areas. All desert tortoises found shall be marked and removed from the enclosures and placed outside the nearest fence. If the removal is during the season of above-ground activity, the desert tortoises shall be placed beside a nearby burrow of appropriate size. If the removal is not in the season of above-ground activity, the desert tortoise shall be moved (dug out of burrow if necessary) on a seasonably warm day and placed at the mouth of a nearby burrow of appropriate size. If the desert tortoise does not enter the burrow, an artificial burrow may be needed. The authorized biologist shall be allowed some judgment and discretion to ensure the survival of the desert tortoise is likely.

- Desert tortoises moved from within a fenced site shall be marked for future identification. An identification number using the acrylic paint/epoxy covering technique shall be placed on the fourth left costal scute (U.S. Fish and Wildlife Service, 1991). 35-mm slide photographs of the carapace, plastron, and the fourth costal scute should be taken. No notching is authorized.

- A protocol specific to the handling of hatchlings shall be developed. The following are some measures that shall be considered: hatchling marginal scutes (a part of the tortoise shell) shall be marked with water-based paint; since the home range for hatchlings is approximately 50 meters, if a hatchling is found, the area within a 160-foot radius shall be searched for additional juveniles and/or a tortoise nest. The capture site shall be well-marked, and either fenced with tortoise-proof fencing or monitored.

- Reduction of habitat fragmentation caused by installation of above-ground pipelines shall be accomplished in several ways; the pipe could be buried flush with the surface for 100 feet approximately every one-half mile; or a 100-foot long earthen ramp with a 15 percent slope could be built over the pipe approximately every one-half mile; or the pipe could be elevated one foot above the ground.

- The BLM shall ensure that common ravens do not nest on any structures erected by FCMC. Any above-ground utility poles shall be designed and installed to preclude nesting by common ravens. If common ravens construct nests on its facilities, FCMC or the BLM shall be responsible for obtaining the appropriate permit from the USFWS's Division of Law Enforcement to remove the nests. The BLM shall also ensure that FCMC monitors common raven use in the vicinity of the proposed facility in accordance with standard BLM raven-monitoring techniques.

- Fragmentation of desert tortoise habitat shall be reduced through the installation of culverts or underpasses under the access roads and the railroad at all washes and at 0.5-mile intervals. Culvert size, location, and installation shall be in accordance with methods developed by the BLM/s Desert Tortoise Research Group. Culverts or underpasses shall be maintained to remove trash and other debris at least twice per year and to ensure that they are in all ways passable to desert tortoises, prior to its spring and late summer activity periods.

- Pets, especially dogs, shall not be permitted on site, thereby reducing the possibility of harassment of tortoises, tortoise fatalities, or the destruction of tortoise habitat.

- At the end of the project, disturbed areas, including new access roads, shall be recontoured and reseeded with an appropriate mixture of native plant species according to BLM specifications. After site rehabilitation, all desert tortoise-proof fences shall be removed.

- The project proponent shall acquire and transfer to the BLM 341 acres of off-site desert tortoise habitat lands to compensate for the unmitigated impacts of the project on the desert tortoise. All compensation lands shall be within BLM-designated Category I Tortoise habitat with the West Mojave Region and shall be approved by the BLM prior to satisfaction of this requirement. Acquisition of compensation lands shall be coordinated through the BLM/s California Desert District Realty Staff. Compensation requirements must be satisfied within one year of mining plan authorization. The original Fort Cady project habitat compensation was recalculated by the BLM, based on a revised formula adopted on October 15, 1992. The revised BLM formula requires that in Category III habitat, disturbed land be replaced on a 1:1 basis. Based on this information, the BLM has determined that 341 acres shall be acquired by FCMC and transferred to the BLM. The land should be transferred within a year of the mining plan authorization (BLM, 1992).

- Upon locating dead, injured, or sick desert tortoises, initial notification must be made within three working days of the finding to the U.S. Fish and Wildlife Service's Division of Law Enforcement in Torrance, California, at (310) 297-0062. The U.S. Fish and Wildlife Service's Ventura office shall also be notified at (805) 644-0062. Written notification to both offices must be made within five calendar days and include the date, time, and location of the carcass, a photograph, and any other pertinent information. Care shall be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state. The BLM shall endeavor to place the remains of intact desert tortoises with educational or research institutions holding the appropriate State and Federal permits per their instructions. If such institutions are not available or the shell has been damaged, the information noted above shall be obtained and the carcass left in place. The BLM shall consider marking the carcass in a manner that would not be toxic to other wildlife to ensure that it would not be rerecorded in the future.

  Arrangements regarding proper disposition of potential museum specimens shall be made with the institution by the BLM prior to implementation of the action. Injured animals should be transported to a qualified veterinarian. Should any treated desert tortoises survive, the U.S. Fish and Wildlife Service shall be contacted regarding final deposition of the animal.

4.1.6 LAND USE / RECREATION

Land use impacts generally relate to inconsistencies between existing land use policies and management guidelines and proposed land uses; conflicts with uses adjacent to or in the proximity of the project; and land use conversion (including the size and type of the change and relationships between existing uses and proposed land uses).

4.1.6.1 CONSTRUCTION IMPACTS

Construction activities would include equipment operations, materials delivery and stockpiling, utilities installation, and facilities construction. These activities may conflict with surrounding land uses and the uses presently found in the project area. Activities may conflict with dispersed (off-road) recreation use, but due to the availability of vast areas of desert open space for recreational activities, this impact is considered adverse but not significant. Potential adverse impacts are not expected to be significant due to the low-intensity use associated with desert open space and utility corridors and the land-use similarities associated with the adjacent Hector Mine.

4.1.6.2 OPERATION IMPACTS

Potentially significant adverse impacts may be associated with the inconsistency between the proposed process plant building height (75 feet) and two planning policies: (1) the building height standard of 35 feet found in the County's Rural Conservation (RC) Land Use District, and (2) the Airport Hazard Overlay Zone (AR-4) situated over the site, which imposes a maximum building height of 35 feet due to low-flying, high-speed military aircraft. In addition, mining facilities and the scientific/educational purposes delineated for the Pisgah Lava Flow interim Research Natural Area and proposed Area of Critical Environmental Concern (ACEC) may dictate additional mitigation measures to ensure compatibility of land uses.

Inconsistency with the County RC District building height restriction is expected to be addressed through application for a major variance filed with the County in conjunction with the mining Conditional Use Permit. The County Development Code allows for building heights above 35 feet if other conditions are met (including increases in setback distances from property lines). The site is large enough to integrate set-back adjustments, and the existing transmission lines adjacent to the project site have already set a precedent for non-standard structure heights in the area (80-100 feet). Due to these factors, the variance, submitted in conjunction with the Conditional Use Permit required for the site, is expected to be approved (Rush, 1992). Therefore, this impact would not be considered significant.

The conflict with the AR-4 Hazard Overlay Zone is also expected to be addressed through a variance filed and approved with the Conditional Use Permit. The flight corridors affecting the project area are presently used for training purposes by Edwards Air Force Base. Flights normally remain a minimum of 300 feet above the ground, although clearance has been granted to a minimum of 100 feet (slightly greater clearances are required near transmission lines). Personnel managing the corridor do not foresee any conflicts with the proposed 75-foot building height (Benge, 1992). Proposed development is normally encouraged within close proximity of existing transmission line corridors in order to alleviate low-flight hazards; the processing plant location satisfies this requirement due to its close proximity to the east side of the area's transmission line corridor. Therefore, this impact would not be considered significant, and no additional written approvals (other than the County permit) or hearings would be required.

Adverse impacts associated with conflicts between the proposed action and the research/education purposes of the proposed Pisgah Crater ACEC designation could be potentially significant if proposed facilities degrade or destroy existing research projects or special features associated with on-going education visits.

California Desert Conservation Area Plan

Proposed facilities located within the Special Area as defined by the CDCA Plan include all of the proposed facilities, with the exception of the water wells and the associated above-ground piping. Potentially significant adverse impacts are identified in Section 4.1.5 for Biological Resources as a result of conflicts with facilities and research projects or educational features. Mitigation measures described in Section 4.1.5.4 would be incorporated to reduce impacts so that they are not significant. These measures would likely correlate with proposed measures to mitigate potentially significant adverse impacts to biological resources.

In addition, mining operations and facilities would again limit desert recreation in the project area through conversion of desert open space to industrial uses, but this is viewed as an adverse but not significant impact, due to the relatively low importance of off-road vehicular and hiking activities in the area.

The operation of the proposed mine is not expected to result in significant adverse impacts because it represents an expansion of the dominant existing industrial uses of the immediate surroundings rather than conversion to totally new uses.

4.1.6.3 CLOSURE IMPACTS

Impacts associated with closure (including disassembly of facilities and the construction procedures used to reclaim disturbed areas) may conflict with other land uses (such as off-road recreation). Conflicts should be minimal, however, and would be considered adverse but not significant. After closure is completed, the project site would be available for other uses consistent with the County

RC district or Class M within the CDCA Plan. Such uses could include dispersed recreation, utility corridors, and desert open space.

4.1.6.4 MITIGATION

Mitigation for potential land use conflicts includes the approval of variances incorporated into the Conditional Use Permit for building height allowances and a three-part approach to mitigate potential significant impacts within the Research Natural Area and/or proposed ACEC, if the designation is approved:

- Avoidance of areas deemed to be sensitive by the BLM;
- Raised installation of piping and equipment to minimize ground disturbances; and
- Consultation with the BLM and affected parties to refine potential impacts and mitigation requirements.

4.1.7 VISUAL RESOURCES

Existing plans, policies and management objectives for visual resources were identified for all jurisdictions in the project area; the relative level of contrast associated with the project was assessed using the BLM Contrast Rating System; and an evaluation of significance was made based upon the consistency of the proposed action with planning guidelines and the relative amount of contrast/quality degradation associated with the project characteristics.

The project includes a variety of facilities with a wide range of visual characteristics (refer to the Project Description, Section 2.0). The rail spur represents a flat, linear feature with a consistent pattern. It would be the most visible element of the project from the I-40 corridor. The excavation for the natural gas pipeline would follow the existing Pisgah Crater access road. The pipeline would be visible from the highway corridor, but the parallel installation would likely lessen the contrast associated with the pipeline. The proposed access road which connects the Pisgah Crater access road with the mining facility would parallel the proposed rail spur in a common right-of-way for approximately 1.5 miles; this would represent a strong linear ground-plane landscape feature. In addition, the proposed overhead wood-pole electric distribution line would parallel the rail spur and add additional visibility to the right-of-way in views from the Pisgah Crater access road.

The process plant is the largest, most prominent structural project feature, characterized by an angular vertical form. A variety of activities would be associated with the plant, including the loading/unloading of materials and products, and on-going maintenance and operations procedures.

The gypsum deposition area would retain a somewhat natural character throughout most of its expected period of use. The two earthen dams would appear as prominent horizontal lines/forms, but their color and texture would minimize contrasts with the landscape. There would be no major mechanical features associated with the area except for the relatively small, slurry pipeline, which would move gypsum from the process plant to the deposition area, and the small, water return pipeline, which would return water from the gypsum deposition area to the process plant for re-use. Pipelines will be manufactured of plastic or fiberglass and have low-reflective character.

The remainder of the proposed facilities, including the well-field access road, the well-heads, and the water well pipeline and water wells, are expected to be less visually dominant than the features previously described. Above-ground piping would be visible throughout the well-field area and along the five-mile area where water wells would be drilled, but the small size and scale of the piping should minimize the visibility and potential contrast of the piping with the landscape.

The BLM Visual Contrast Rating System was used to qualitatively measure the degree of contrast between the proposed action and the existing landscape. Each visual management class (I to V) has an allowable level of contrast; the lower the number of the class, the less the amount of allowed contrast in the area. The allowable level of contrast for Class II is defined as "can be seen but does not attract attention." Class III allows "moderate" contrast; that is, "the element contrast begins to attract attention and begins to dominate the characteristic landscape." Refer to Figure 3.7-2 for a map depicting the Management Class areas.

The contrast rating system typically relies on the use of visual simulation techniques to illustrate the form and general features of the proposed action from viewpoints which represent high viewer sensitivity (based on user volumes and user attitudes). The three selected key viewpoints provide several of the views most likely to be experienced by a wide variety of public viewers. Viewpoints D and E represent typical views from I-40, and Viewpoint F represents a typical view from the Pisgah Crater access road (refer to Figures 4.1.7-1a and -b for the view photographs, and Figure 3.7-2 for view locations). Construction workers who build and close the plant, the plant employees, and to a lesser degree, the Hector Mine employees, would all experience daily views of the operations at distances closer than the typical public views. The three typical viewpoints reflect public views from (1) the highest user volume corridor in the region; and (2) public views from the closest defined public access to the proposed plant site.

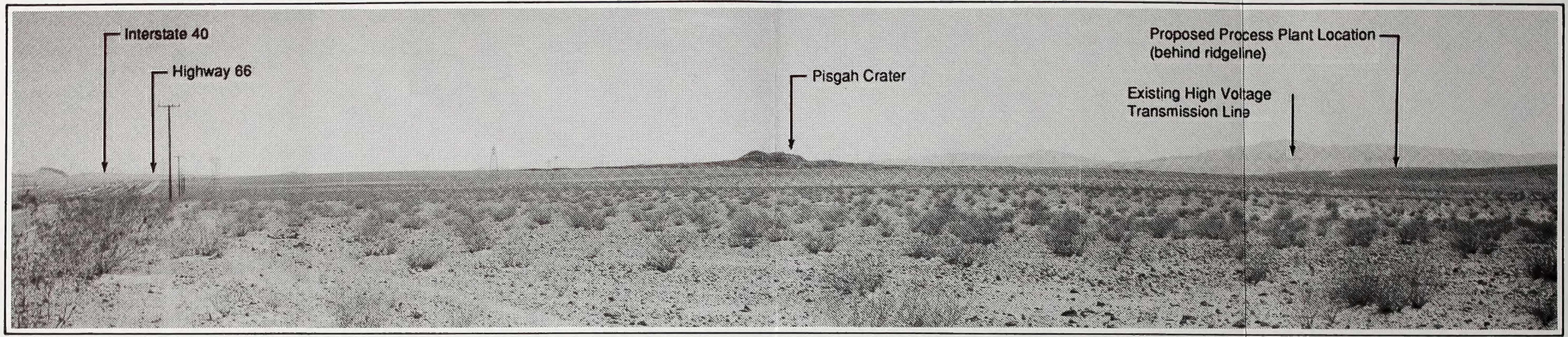
The key viewpoints have been annotated to show the approximate location of the process plant, which is the tallest and potentially the most noticeable project feature. Due to the distance and intervening topography between the I-40 viewpoints and the proposed plant, plant visibility is expected to be very limited (Figure 4.1.7-1a). The approximate viewshed shown in Figure 3.7-2 was calculated through analysis of site cross-sections and potential view blockage from existing topographic elevations. Visibility of the plant in this viewshed is varied and minimal at best. Viewpoint elevations and top-of-structure elevations in this viewshed vary by approximately 20 feet, so visibility of the structure would be limited to the top 25 percent of the building where views to the project site are possible. The proposed rail spur would also be potentially visible from Viewpoint E. As shown in the photograph, however, the location, oblique alignment and relative scale of the track would limit the visibility and potential contrast of the facility with the surrounding landscape.

The viewpoint on the Pisgah Crater access road is located approximately one mile from the process plant (Figure 4.1.7-1b). The relative size of the process plant (75’ maximum height, 400’ width) was shown in the viewpoint photograph based upon the relative scale and dimension of the high-voltage transmission line located immediately behind the plant. Industry standards were assumed for the height (80-100 feet) and spacing (1,000 feet) of the transmission towers. The resulting depiction of plant visibility shows that even at the closer views available from the Pisgah Crater access road, the plant is not expected to create a substantial contrast with the surrounding landscape.

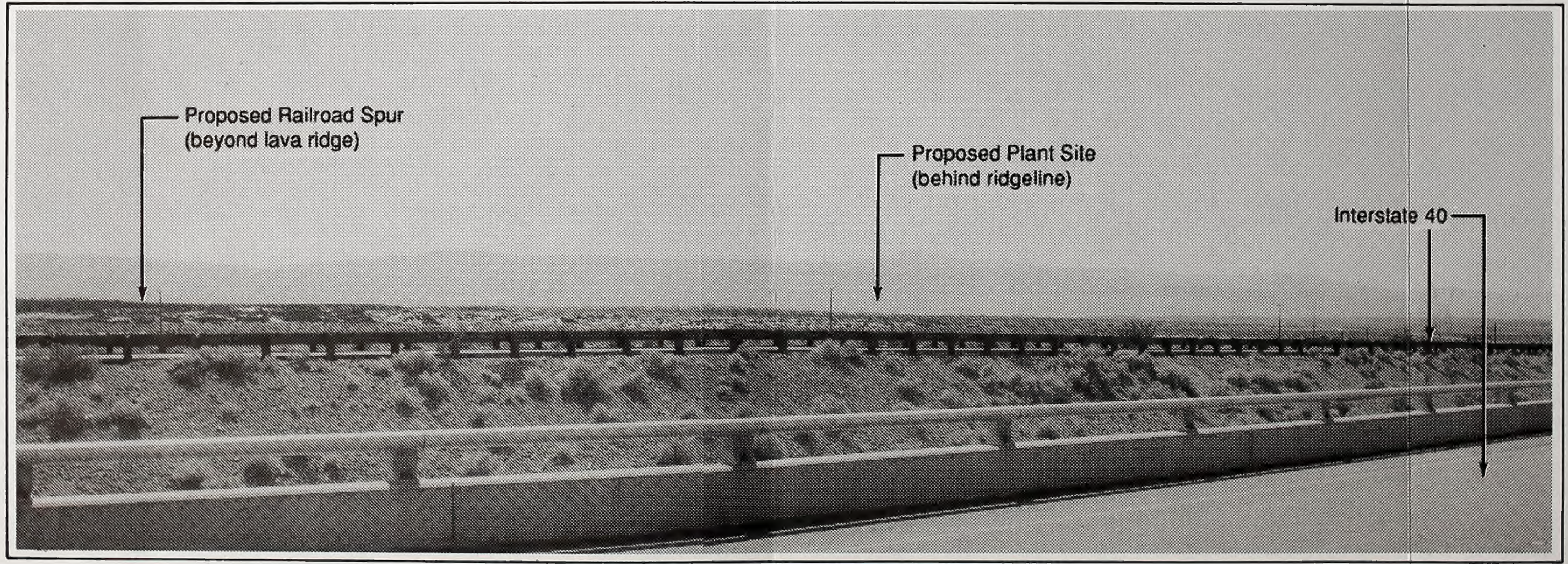
The contrast analysis is summarized in Tables 4.1.7-1, -2, and -3. In addition, the following criteria were considered when applying the rating system (refer to Section 4.1.7.2 for a discussion of their application):

Distance
Angle of Observation
Length of Time Project is in View
Relative Size or Scale
Season of Use
Light Conditions
Recovery Time
Spatial Relationships
Atmosphere Conditions
Motion

Based upon the contrast and visibility evaluation of the proposed action and the consistency with planning policies, the impact evaluations were completed and are summarized in the following sections.


Interstate 40
Highway 66
Pisgah Crater
Proposed Process Plant Location (behind ridgeline)
Existing High Voltage Transmission Line

Viewpoint D


Proposed Railroad Spur (beyond lava ridge)
Proposed Plant Site (behind ridgeline)
Interstate 40

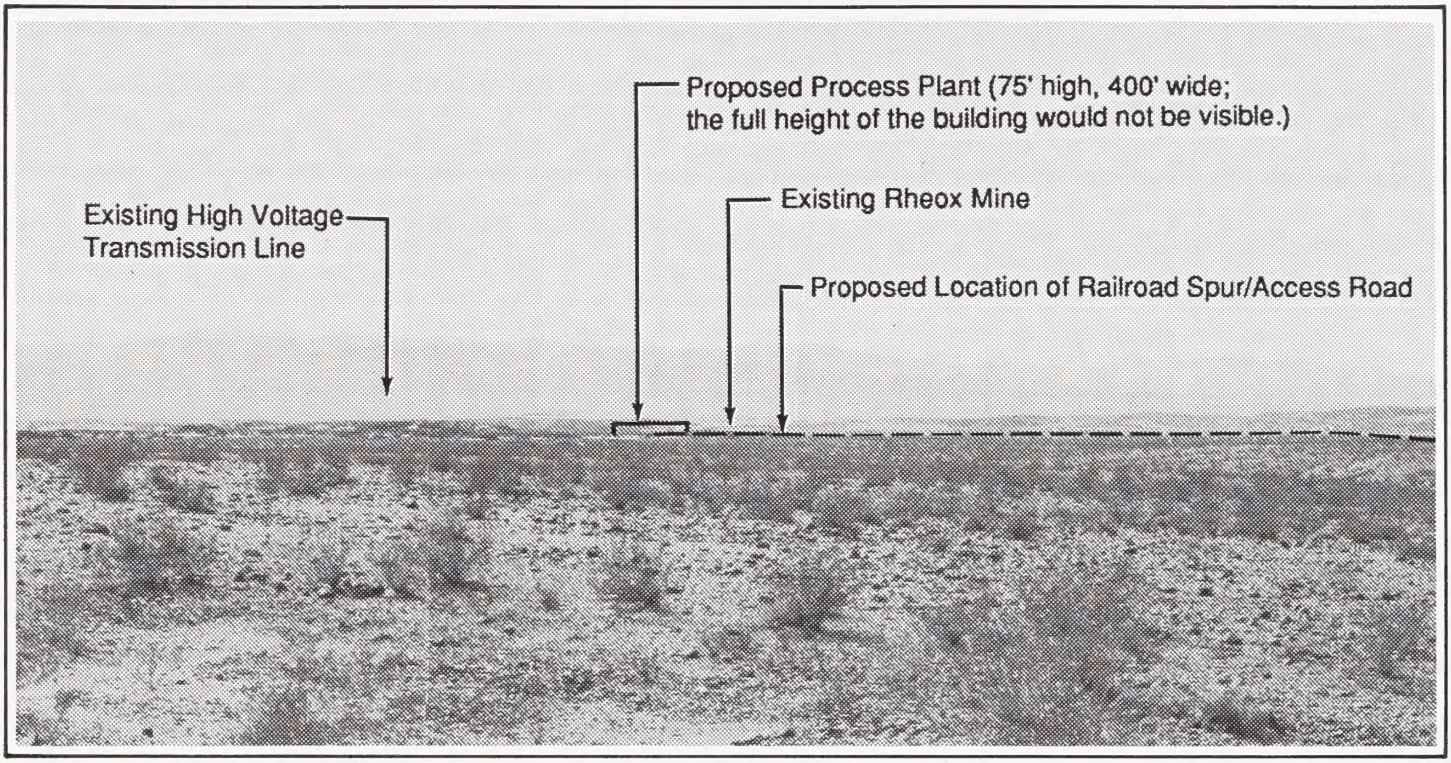
Viewpoint E

VISUAL RESOURCES CONTRAST RATING KEY VIEW POINTS

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

FIGURE 4.1.7-1a

DAMES & MOORE
21864-001-001.VRCRKV


Proposed Process Plant (75' high, 400' wide;
the full height of the building would not be visible.)
Existing High Voltage Transmission Line
Existing Rheox Mine
Proposed Location of Railroad Spur/Access Road

Viewpoint F

VISUAL RESOURCES CONTRAST RATING KEY VIEW POINTS

Fort Cady EIS / EIR
Fort Cady Minerals Corporation
Newberry Springs, California

DAMES & MOORE

21864-001-001.VRCRKV

FIGURE 4.1.7-1b

Table 4.1.7-1

Visual Contrast Rating Worksheet

SECTION A. PROJECT INFORMATION

1. PROJECT NAME Fort Cady In-Situ Mining	4. LOCATION San Bernardino County	
2. KEY OBSERVATION POINT F	TOWNSHIP 8N	
3. VRM CLASS III	RANGE 5E	SECTION 25

LOCATION SKETCH

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. Land / Water	2. Vegetation	3. Structures
Form	Flat, rolling	Indistinct	Angular, linear
Line	Horizontal, diagonal	Weak horizontal patterns	Horizontal
Color	Sand light tan, lava med-to-dark gray	light green/gray to light yellow/brown	dark gray to light gray
Texture	Smooth to lightly coarse	Fine	Smooth

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. Land / Water	2. Vegetation	3. Structures
Form			Flat, slightly angular
Line			Horizontal
Color			Tan or gray
Texture			Smooth

SECTION D. CONTRAST RATING: ☑ Short-Term ☑ Long-Term

1. Degree of Contrast	Features											
	Land / Water body (1)				Vegetation (2)				Structures (3)			
	S*	M	W	N	S	M	W	N	S	M	W	N
FORM		✓					✓			✓		
LINE		✓					✓				✓	
COLOUR			✓				✓				✓	
TEXTURE			✓				✓				✓	

2. Does project design meet visual resource management objectives?
☑ Yes ☐ No
(Explain on reverse side)

3. Additional mitigating measures recommended?
☑ Yes ☐ No
(Explain on reverse side)

Refer to Section 4.1.7.4 for a discussion of management objectives and mitigation measures.

* S = Strong M = Moderate W = Weak N = None

Table 4.1.7-2

Visual Contrast Rating Worksheet

SECTION A. PROJECT INFORMATION

1. PROJECT NAME Fort Cady In-Situ Mining	4. LOCATION San Bernardino County	LOCATION SKETCH
2. KEY OBSERVATION POINT D	TOWNSHIP 8N	
3. VRM CLASS III	RANGE 5E SECTION 25	

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. Land / Water	2. Vegetation	3. Structures
Form	Flat, rolling	Indistinct	Angular, linear
Line	Horizontal, diagonal	Weak horizontal patterns	Horizontal
Color	Sand light tan, lava med-to-dark gray	light green/gray to light yellow/brown	dark gray to light gray
Texture	Smooth to lightly coarse	Fine	Smooth

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. Land / Water	2. Vegetation	3. Structures
Form			Flat, linear
Line			Vertical — utility poles
Color			Brown to gray
Texture			Smooth

SECTION D. CONTRAST RATING: ☐ Short-Term ☑ Long-Term

1. Degree of Contrast	Features												2. Does project design meet visual resource management objectives? ☑ Yes ☐ No (Explain on reverse side)
	Land / Water body (1)				Vegetation (2)				Structures (3)				
	S*	M	W	N	S	M	W	N	S	M	W	N	3. Additional mitigating measures recommended? ☑ Yes ☐ No
FORM				✓				✓				✓	
LINE			✓					✓			✓		Refer to Section 4.1.7.4 for a discussion of management objectives and mitigation measures.
COLOUR			✓				✓				✓		
TEXTURE				✓				✓				✓	

* S = Strong M = Moderate W = Weak N = None

Table 4.1.7-3

Visual Contrast Rating Worksheet

SECTION A. PROJECT INFORMATION

1. PROJECT NAME Fort Cady In-Situ Mining	4. LOCATION San Bernardino County	LOCATION SKETCH
2. KEY OBSERVATION POINT E	TOWNSHIP 8N	
3. VRM CLASS III	RANGE 5E SECTION 25	

SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. Land / Water	2. Vegetation	3. Structures
Form	Flat, rolling	Indistinct	Angular, linear
Line	Horizontal, diagonal	Weak horizontal patterns	Horizontal
Color	Sand light tan, lava med-to-dark gray	light green/gray to light yellow/brown	dark gray to light gray
Texture	Smooth to lightly coarse	Fine	Smooth

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. Land / Water	2. Vegetation	3. Structures
Form			Flat, linear
Line			Horizontal — visible roadway Vertical — utility poles
Color			Brown to gray
Texture			Smooth

SECTION D. CONTRAST RATING: ☐ Short-Term ☑ Long-Term

1. Degree of Contrast	Features												
	Land / Water body (1)				Vegetation (2)				Structures (3)				2. Does project design meet visual resource management objectives? ☑ Yes ☐ No (Explain on reverse side)
	S*	M	W	N	S	M	W	N	S	M	W	N	3. Additional mitigating measures recommended? ☑ Yes ☐ No
FORM				✓				✓			✓		
LINE			✓				✓					✓	Refer to Section 4.1.7.4 for a discussion of management objectives and mitigation measures.
COLOUR			✓				✓				✓		
TEXTURE				✓				✓				✓	

* S = Strong M = Moderate W = Weak N = None

4.1.7.1 CONSTRUCTION IMPACTS

Impacts related to construction activities (except for drilling of new wells) are expected to be of short duration and would not adversely impact the visual resources of the project area to a significant level. Impacts may include soil and vegetation disturbances associated with equipment operations or the temporary placement of staging and storage areas, increased project visibility due to dust and equipment exhaust, and the active character of the equipment and work force in comparison to the passive nature of the existing desert open space. Impacts are not expected beyond the areas required for equipment maneuvering and normal equipment operations and storage.

4.1.7.2 OPERATION IMPACTS

SAN BERNARDINO COUNTY

The project is expected to be consistent with existing county visual resources policies. The County has not established any areas in the vicinity of the project which would receive special scenic quality consideration or protection. In addition, the major roads (I-40 and National Trails Highway) that pass near the project area and provide viewer access to the project are not considered scenic corridors at this time. Since the project is consistent with existing County policies, significant adverse operations impacts are not expected.

BLM

The Contrast Rating Assessment performed to evaluate the proposed action identified a weak to moderate level of contrast between the project and the existing landscape (see discussion above). Views from the key observation points defined earlier were analyzed to document existing conditions and the potential contrasts caused by the proposed facilities. Various factors influenced the application of the assessment procedure, including:

- **DISTANCE** — The minimum viewing distance to the process plant from established public right-of-way is approximately 1.5 miles. Shorter views are possible for dispersed recreational sightseers. Viewing distances to proposed less prominent facilities (such as the railroad spur) vary from several feet to several miles. In general, the distance between the prominent project features (including the process plant building and process water surge tank) and the highway and access road corridors minimizes but does not eliminate the level of potential contrast viewed from the public corridors. Non- or low-reflective building surfaces will also tend to minimize contrasts in views where a portion of the building remains visible.

- **ANGLE OF OBSERVATION** — The proposed action is at approximately the same elevation as the key observation points. In addition, the process plant would be located on a site sloping slightly away from the observer points.

- **LENGTH OF VIEW DURATION/NUMBER OF VIEWERS** — The existing landform located to the north, northwest, and northeast of the project area screens a major portion of potential views of the project area from the highway corridor. The viewing duration for travelers on I-40 is approximately 1.5 minutes. Given other project constraints, the project could not be sited to further lessen this "window" of viewing opportunity. Views for travelers on the Pisgah Crater access road are potentially several minutes in duration, but relatively few people would view the facilities from the road.

- **RELATIVE PROJECT SIZE OR SCALE** — The proposed action is relatively large with respect to other visual features in the area (the process plant would cover approximately 10 acres and the project would stretch approximately seven miles from east to west). This scale heightens the potential for contrast, although the vast scale of the surrounding desert lessens the perceived scale of the proposed action from the key observation points.

- **LIGHT CONDITIONS** — Most views (including the key viewpoints) to the project site are oriented in a south-to-southwest direction. The lower sun angles associated with fall, winter, and spring seasonal changes potentially decrease project area visibility due to glare, especially if hazy conditions exist.

- **RECOVERY TIME** — Vegetation disturbances associated with project construction and operations are typically slow to recover in a desert environment. Contrasts would likely be heightened due to this factor.

Most project features are located in the Class III Visual Management Zone. As discussed above, moderate contrasts are allowed in these areas. Based on the Contrast Ratings and results of other analyses completed, the project should meet the moderate contrast requirement for Class III. The portion of the project which is located in a Class II zone (the less-prominent well-field and water pipeline) should also meet visual management requirements. The zone permits weak contrasts which "can be seen but do not attract attention." Due to the relative low visibility of the facilities and the horizontal orientation and small scale of the well heads, pipelines, and access roads, contrasts are expected to be weak. Since all contrasts are expected to remain within the allowable limits prescribed by the BLM Visual Resource Management Zone, operation impacts to visual resources are expected to be adverse but not significant.

4.1.7.3 CLOSURE IMPACTS

Closure impacts associated with the removal of all facilities and the reclamation of landforms and vegetation would be considered adverse due to the contrast between the required equipment and activities and the passive open space character of the desert landscape. Impacts would be short-term and only partially visible, however, and would not be considered significant.

4.1.7.4 MITIGATION MEASURES

The adverse visual impacts associated with potential project contrasts, even though not considered significant, would still be minimized as per the overall goal of BLM Visual Resource Management. Visual impacts are closely associated with the relative contrast between the characteristics of a project and the landscape character of its setting. Effective mitigation typically calls for minimizing landform and vegetation disturbances, strategic placement of facilities in less visible, less sensitive locations, and repetition of the basic design elements (form, line, texture, and color) in order to effectively blend disturbances or structures with existing site characteristics. Visual resource impact mitigation is addressed through procedures and standards defined by Federal regulations (43 CFR 3809) for reclamation of mining operations on Federal lands. In addition, Surface Mining and Reclamation Act (SMARA) requirements also affect visual resources through stipulations involving reshaping and revegetation of disturbed areas.

Mitigation measures recommended to minimize potential adverse visual impacts include:

DESIGN/CONSTRUCTION

- Project engineers shall be directed to incorporate landform screening wherever feasible.

- The area of disturbed surfaces within lava flow areas would be minimized wherever possible to reduce the visibility of lava/soil contrasts; where disturbances are unavoidable, cut/fill slopes and graded surfaces shall gradually blend the color, texture, and contour of adjacent sand and lava surfaces.

- Visible disturbances in other areas would be minimized wherever possible. Grading for the railroad spur and access roads would be minimized; and access for all construction equipment would be restricted to the minimum area required for operations and maneuvering (see Biology Mitigation, Section 4.1.5.4).

OPERATION

- A BLM plan which addresses vegetation and soil disturbances is on file with the BLM and San Bernardino County, and is available for public inspection.

- Structures shall be painted, stained, or built with materials using integral color to blend with the predominant background as viewed from the highway corridor and access road. Colors shall be chosen in conjunction with the BLM from their normal earth-tone color series.

- Project engineers shall be directed to locate and shield night-lights to minimize off-site glare and visibility.

CLOSURE

- Surface disturbances shall be regraded to lessen contrasts with form, line, and varied soil/sand/lava colors related to the unnatural linear project facilities. Surfaces constructed in the gently rolling topography shall be flattened.

- A BLM plan which addresses closure issues related to site features and disturbances is on file with the BLM and San Bernardino County, and is available for public review.

4.1.8 TRANSPORTATION

4.1.8.1 CONSTRUCTION IMPACTS

A short-term increase in traffic is expected to result from the necessity of commuter trips for construction workers and the trucking of construction materials and equipment. Table 4.1.8-1 indicates the approximate traffic increases associated with several key phases of construction:

TABLE 4.1.8-1

CONSTRUCTION-RELATED TRAFFIC

Phase	Duration	No. of Workers Required	Associated Trips/Day
Project Site Access Roads	1 month	8	16
Well Pipelines	1 week	4	8
Main Access Road	1 month	8	16
Well-Field	9 months	21	42
Process Plant/Office	9 months	25	50
Gypsum Deposition Area	1 month	10	20
		Total:	**152**

Depending upon phase overlap, a maximum of 152 trips per day would be expected during project construction. This number assumes that no carpooling exists. In addition, it does not reflect the ancillary facilities construction that would be performed by others, but the worker numbers required for the rail spur and utilities installation are not expected to be substantial. The increase of 152 trips per day represents a 2- to 15-percent increase in daily trips for traffic on the National Trails Highway at the Newberry interchange and on I-40 at the Hector interchange. The small percentage increase to existing low-volume traffic counts would be considered an adverse but not significant impact.

Construction of the rail spur would potentially interrupt traffic on the National Trails Highway at the road and railroad crossing, but expected adverse impacts would be short-term and not significant. The construction associated with the rail spur connection to the Pisgah Siding adjacent to the mainline tracks would take siding trackage out of service on a short-term basis, but the adverse impact associated with the trackage interruption would again not be considered significant.

4.1.8.2 OPERATION IMPACTS

Seventy-nine permanent employees are expected to work at the proposed facilities. Approximately 65 of these employees would commute to the site in a standard 24-hour period, assuming that one operating staff crew would not report for duty each day. Sixty-five employees would add an additional 130 employee vehicle trips-per-day to the existing traffic count, again assuming that no carpooling would take place.

In addition, shipments of operational supplies would include three bottled water deliveries per week, one load of non-hazardous waste removed per week, and two truck shipments of parts and supplies per week. Truck shipments of gypsum and boric acid, assuming that one-third of production (58,670 tons per year) would be shipped by truck, would add approximately 16 trips per day (2,934 loads at 20 tons/load). The total number of truck trips per day would equal 28; the total number of all vehicle trips per day would equal approximately 158. This increase in traffic would represent a less-than-significant adverse impact to traffic on I-40 or National Trails Highway.

Railcar shipments of operational supplies would include bulk hydrochloric acid and bulk sulfuric acid (approximately 600 cars per year @ 100 tons per car). These additional rail cars would be attached as needed to the current two trains per day that serve the area. The trains would make an additional stop at the proposed site via the new rail spur. Out-going product shipments of boric acid and gypsum would total approximately 1,173 carloads per year (approximately three rail carloads per day), assuming production meets anticipated estimates, maximum loading is 100 tons of product per car, and approximately two-thirds of product shipment is by rail.

Based on the carloadings and assumptions outlined above, no significant adverse impacts to existing rail operations would be expected (Monday, 1992).

4.1.8.3 CLOSURE IMPACTS

A variety of equipment and manpower would be required to dismantle the plant and regrade the site and access road and railroad right-of-way. Adverse impacts similar to those expected during construction would occur to the highway and railroad systems at the time of closure, and they would again not be expected to be significant.

4.1.8.4 MITIGATION

None required.

4.1.9 CULTURAL RESOURCES

Since this project requires Federal approval, work must be performed in compliance with Section 106 of the National Historic Preservation Act. Regulations governing the Section 106 cultural resources review process are presented in 36 CFR 800. Included in these regulations are provisions for programmatic agreements between agencies and the Advisory Council. Under the California Programmatic Memorandum of Agreement, the BLM is to consult with the State Historic Preservation Officer (SHPO) in a manner consistent with the "Secretary of the Interior's Standards and Guidelines for Evaluation" and 36 CFR 63 to ensure that historic properties are evaluated to determine their eligibility for inclusion in the National Register. In addition, under a joint EIS/EIR, significance criteria established under Appendix K of CEQA are to be taken into consideration.

Evaluation of the sites potentially affected by the project (see Section 3.9.2) has been conducted; recommendations regarding National Register eligibility have been submitted to the BLM. BLM, as lead federal agency, developed determinations of eligibility and determinations of effect as described in 36 CFR 800, and will subsequently consulted with the State Historic Preservation Officer.

4.1.9.1 CONSTRUCTION IMPACTS

The majority of effects on cultural resources are likely to occur during project construction. Impacts to be considered would include, but not necessarily be limited to, the destruction or displacement of cultural deposits and the loss of scientific information.

The construction activities for the proposed action would impact 19 cultural resources. Three additional sites were identified, but through redesign of the project they are now outside areas proposed for disturbance. All of the 19 resources have been evaluated. A portion of one site, the National Trails Highway (CA-SBR-6693H) had previously been evaluated and determined to be eligible for the National Register. This determination was for a small segment of the road and was for project-specific impacts from a pipeline. The determination was established by agreement between SHPO and a federal agency, not by the Keeper of the Register. Evaluation of the segments of the site crossed by the Fort Cady project looked at the eligibility on the merits of the part of the resources in the APE.

A testing and evaluation plan approved by the BLM was implemented to assist in assessing National Register eligibility of the sites potentially affected by the Fort Cady Project (Apple, et al., 1993). Based on the results of these investigations, none of the sites were recommended eligible for the National Register. No impacts to significant cultural resources are anticipated.

4.1.9.2 OPERATION IMPACTS

Operation of the proposed action should not include any new disturbance, so no new additional potential or significant adverse impacts are anticipated. However, operational activities could have indirect effects on cultural resources, particularly those close to the facilities. Maintenance activities could impact cultural resources that were not impacted during construction. With increased personnel in the area, impacts could result from artifact collection and increased vehicle traffic. Reduction of these potentially significant impacts should be addressed through worker education.

4.1.9.3 CLOSURE IMPACTS

Impacts to cultural resources during closure would be similar to those during operation, since no new disturbance is expected.

4.1.9.4 MITIGATION

Avoidance of impacts is generally the preferred mitigation measure for cultural resources. This is because other forms of mitigation are necessarily incomplete and result in the loss of resource integrity, and, in the case of archaeological resources, the loss of scientific information.

Since known cultural resources exist in close proximity to project facilities, worker education shall be implemented. Under this program, employees and perhaps even visitors to the project area shall be told of the importance of not disturbing cultural resources.

Given the inherent difficulty in identifying archaeological sites based on surface indications, it is possible that previously unidentified cultural materials could be encountered during construction activities. If previously unidentified cultural resources are encountered, construction activities shall be halted until a qualified archaeologist is consulted regarding the significance of the finds. Concerned Native Americans shall be involved in the evaluation where appropriate, such as in the case of possible human remains. The BLM shall be notified and an approved data recovery program or other mitigation measure devised.

4.1.10 PALEONTOLOGICAL RESOURCES

4.1.10.1 CONSTRUCTION IMPACTS

No fossils of any kind were discovered during the field survey in the two rock sequences, nor were any caves or packrat middens found that dated prior to recent times. There is some potential, however, that scientifically significant paleontological resources may be uncovered during construction. Such fossil resources could be subject to destruction and loss as a consequence of construction activities. Therefore, a potentially significant adverse impact could result to paleontological resources.

Indirect effects of the construction of the proposed action (e.g., increased visitation, off-road vehicle traffic, illegal dumping, and accelerated erosion) could result in an adverse impact to paleontological resources. However, this impact would not be significant, since the project area is remote and this increased activity would be minimal.

4.1.10.2 OPERATION IMPACTS

No additional adverse impacts beyond those discussed for construction are anticipated.

4.1.10.3 CLOSURE IMPACTS

No additional adverse impacts beyond those discussed for construction are anticipated.

4.1.10.4 MITIGATION

Because the potential for significant adverse impacts to paleontological resources exists as a result of the proposed action, the following mitigation measures are recommended:

- A spot check of construction activities shall be performed by a qualified paleontologist in areas where ground disturbing activities are most likely to encounter paleontological resources, such as at the sites where the proposed process plant and gypsum deposition area dams are to be constructed.

- Construction personnel shall be appraised of the potential for uncovering scientifically significant fossil remains during construction and the protection that such resources are afforded under California state and Federal legislation. Should any fossils be uncovered during construction, a qualified paleontologist shall be called immediately to evaluate the significance of the discovery.

4.1.11 SOCIOECONOMICS

4.1.11.1 CONSTRUCTION IMPACTS

Construction impacts to socioeconomics would result from effects on employment, population, housing, the fiscal environment, and public services and utilities.

EMPLOYMENT, POPULATION, AND HOUSING

Project construction is expected to take nine months and require, at maximum, 76 workers. The Barstow area is currently experiencing a high unemployment rate. Based on this and the relatively small number of workers necessary for the project, the existing workforce is expected to be adequate to meet project needs. This would represent a small beneficial impact to employment. Furthermore, no change in population or additional housing requirements would be necessary.

FISCAL ENVIRONMENT

The proposed action is expected to have a small but beneficial impact on local government budgets. This estimate is based on the projection that most of the construction personnel for the project would be existing residents of the area, principally from the City of Barstow, and therefore, the project would not involve relocating people to the area and burdening local public services. As a result, local governments should experience a small but positive cash flow, as revenues from sales and property taxes should exceed the incremental costs of providing public services to the project. In addition, the project would not only be a source of wages and salaries for local residents, thus adding another source of personal income to the local economy, but also the construction itself would require various goods and services from local suppliers. Sales taxes on these purchases as well as those on taxable retail purchases of project personnel, would accrue to city and county governments.

No information is publicly releasable on the potential amounts of local procurement emanating from the construction of the proposed action; therefore, it is not possible to estimate how much local sales tax revenue may be generated. However, this beneficial impact is likely to be small. The purchases by FCMC workers who are existing residents would serve to sustain current levels of business activity.

PUBLIC SERVICES AND UTILITIES

Based on the small size of the project and the short duration of the construction period, impacts to public services within the vicinity of the project area are not expected to be significant. Since the workforce would be hired locally, no change in the population-related demand on public services is anticipated. Sanitary sewage requirements for the project would be handled by portable on-site facilities and non-potable water would be provided by an on-site well. Therefore, no demand on or adverse, significant impact to municipal sewage and water systems would occur. Due to the relatively small size and short construction period of the project, it is not expected that sheriff or fire department capabilities would require expansion.

The project would require construction of a natural gas pipeline to power the on-site cogeneration facility. The pipeline would run parallel to Pisgah Crater Road along the west side and connect within the PG&E main line near the I-40 underpass. Hook up of the new pipeline for the project would not interrupt service downstream and would be considered a standard procedure (Sigala, 1992). Electrical demands for construction of the project would be provided by SCE.

4.1.11.2 OPERATION IMPACTS

Operation impacts to socioeconomics would result from effects on employment, population, housing, the fiscal environment, public services, and utilities.

EMPLOYMENT

The project is expected to employ 79 workers, approximately 65 of whom would be from the local area. Most of the workers, with the exception of skilled engineers, geologists, and the operation manager, would not require specific mining-related skills; in-situ mining equipment (pumps and other related machinery) can be operated by local workers trained by FCMC, and no prior experience is considered necessary.

With 79 employees, The FCMC project would be the largest manufacturing employer in the immediate Barstow area (BCC, 1990). The impact to employment would be considered beneficial.

POPULATION

It is anticipated that the majority (approximately 80 percent) of the project's workforce would be hired locally. Therefore, approximately 15 workers and their families would be expected to relocate to the area. This small number of people is not expected to result in an adverse increase in population size.

HOUSING

Barstow plans to continue the expansion of its housing stock to meet projected growth through the period of project start up (BPD, 1991). Because of this, the relatively small number (i.e., 15) of workers relocating to the area is expected to be accommodated within current growth plans, and no adverse significant impact to housing is expected to result.

FISCAL ENVIRONMENT

Economic impacts during the operation of the proposed action relating to workforce spending and local procurement would be similar to the impacts discussed above for construction. The impacts are expected to be beneficial but minor.

The proposed action would cause the assessed value of the property to be increased. The change in the assessed value can be based on one or more criteria: the capitalized value of its earning potential, the cost of the improvements made to the property, and/or its potential sales value, based on the value of recent sales of equivalent properties. The choice of criteria is up to the County assessor, subject to appeal by the property owner. The cost of the proposed improvements and projections of the operation's potential earnings are classified as trade secrets and are not publicly available. Accordingly, it is not possible to estimate the change in property tax revenues that would occur as a result of the proposed action. At a minimum, however, they would equal approximately one percent of the value of the proposed improvements.

The County is the only governmental entity levying a property tax on the FCMC property. Thus such services as fire and police (i.e., sheriff) protection are provided by the County. The nearby unincorporated community of Newberry Springs has a Community Services District (NSCSD, 1991b) that provides fire protection to its territory as well as street lighting in Newberry Springs itself. Most of the NSCSD's budget is supported by property taxes; during FY 1989-90, the NSCSD had total revenues of slightly over $40,000, of which about $32,600 came from property taxes (State Controller, 1991b). Most of the NSCSD's expenses were for contracted fire protection services (State Controller, 1991b). In 1991, the District indicated that it was considering extending its jurisdictional boundaries to take in the FCMC property as well as a number of other nearby mining operations. If this occurs, then the NSCSD and the County of San Bernardino would split the one-percent property tax revenues, to reflect the transfer of fire protection services from the County to NSCSD. As of February 1992, there was no information on whether or when NSCSD would seek to incorporate the project site into its service area, nor is there any information on what the NSCSD's share of the tax levy would be. The County would continue to provide other services to the site, such as sheriff, public health and the like.

PUBLIC SERVICES

Based on current growth in the Barstow area, the relocation of approximately 15 workers to the area would not increase the demand on public services to a level that could not be accommodated. The project may create some additional demand for emergency services, namely fire and medical services. With the exception of limited on-site fire and security provisions, these services would be provided by the local fire department and the County Sheriff's office in Barstow. Impacts to these services are expected to be adverse but not significant (Worsey, 1991 and Von Oosbree, 1991).

The project would generate only a small volume of refuse. Therefore, impacts of the project on local landfills are expected to be adverse but not significant.

UTILITIES

The PG&E main line would be expected to provide natural gas for the operational lifetime of the proposed action. PG&E considers this project a relatively small consumer (435,100 MSCF annually) and would be able to provide an adequate supply of natural gas (Sigala, 1992).

Electricity required for operation of the project would be provided by an on-site cogeneration facility. Extension of SCE transmission lines to the proposed facility would be required to provide complete backup power (four MW) and the capability to sell excess electricity back to SCE. Because the utility requirements of the proposed action are relatively small, impacts to natural gas and electric utilities are expected to be adverse but not significant.

Non-potable water requirements for the facility would be provided from on-site water wells. Approximately 150 gallons per day of drinking water would be provided by an independent distributor. Because no requirements for provision of water from municipal water districts would be necessary, no impact to the districts would occur.

Sanitary sewage from the facility would be directed to an on-site septic tank and tile bed system. Because sanitary waste would be handled on-site, there would be no impacts to municipal sewage systems.

4.1.11.3 CLOSURE IMPACTS

Impacts related to the closure of the project are expected to be similar to those associated with construction. And, as with the conclusions reached for construction of the project, no significant adverse impacts to socioeconomics are expected for closure.

4.1.11.4 MITIGATION

No mitigation measures are necessary.

4.2 ALTERNATIVE FACILITY LOCATIONS

4.2.1 GEOLOGY

4.2.1.1 ALTERNATIVE SITE #1

A potentially significant adverse impact related to Alternative Site #1 is the increased erosion susceptibility due to construction, operation, and closure soil disturbances. The soil erosion can be mitigated through resurfacing of susceptible areas.

The impacts and mitigation associated with the Alternative Site #1 location are expected to be similar to those associated with the proposed action.

4.2.1.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts to those described for Alternative Site #1 above. There is a negligible difference between the impacts of Alternative Site #2 and the proposed action in terms of geology, soils and seismicity.

4.2.1.3 ALTERNATIVE SITE #3

Alternative Site #3 would have similar impacts to those described for Site #2 in Section 4.2.1.2. There is a negligible difference between the impacts of Alternative Site #3 and the impacts and mitigation associated with the proposed action.

4.2.2 HYDROLOGY

4.2.2.1 ALTERNATIVE SITE #1

Adverse construction impacts (including flooding and erosion) could occur with minor alterations to surface drainage patters and intermittent water use for dust control. The use of appropriate engineering practices during construction, however, would mitigate hazards; none of the anticipated construction impacts to hydrologic resources are expected to be significant.

Operational impacts associated with water quality are expected to be adverse but not significant. Operational impacts associated with consumptive use of groundwater are considered adverse and significant due to potential water drawdown beyond the estimated safe yield of the aquifer. This significant impact is similar to that identified for the proposed action; refer to Section 4.1.2.2 for a detailed description. Impacts associated with potential surface water degradation (including toxic chemical spillage and gypsum pond overflow) are considered adverse but not significant.

In summary, the hydrology impacts and mitigations associated with the Alternative Site #1 location are expected to be similar to those associated with the proposed action.

4.2.2.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts to those described for Alternative Site #1 above. There is a negligible difference between the hydrologic impacts of Alternative Site #2 and the proposed action.

4.2.2.3 ALTERNATIVE SITE #3

Alternative Site #3 would have similar impacts to those described for Alternative Site #1. There is a negligible difference between the hydrologic impacts with Alternative Site #3 and the proposed action.

4.2.3 AIR QUALITY

4.2.3.1 ALTERNATIVE SITE #1

Adverse impacts, in comparison with that resulting from the proposed action, are expected, but cumulative air quality impacts are not anticipated to be significant. Major emission sources would include combustion emissions, fugitive dust emissions from dry product handling equipment, and unpaved roads. Conformance of the project with all established air quality standards is expected.

Impacts and mitigation measures associated with the Alternative Site #1 location are expected to be similar to those anticipated for the proposed action. The shorter access road may slightly lessen fugitive dust associated with vehicular traffic, but the decrease is expected to be negligible.

4.2.3.2 ALTERNATIVE SITE #2

Same as Alternative Site #1 — negligible difference between Site #2 and the proposed action site.

4.2.3.3 ALTERNATIVE SITE #3

Same as Alternative Site #1 — negligible difference between Site #3 and the proposed action site.

4.2.4 NOISE

4.2.4.1 ALTERNATIVE SITE #1

Adverse noise impacts would occur during construction and closure due to construction-related equipment and activities. Adverse noise impacts would also be expected during operations. Drilling, truck and train traffic, and employee traffic would all contribute to an increase in noise levels, but due to a lack of receptors and the background noise generated by the adjacent Hector Mine, I-40 traffic, and the Santa Fe Railway, impacts would not be considered significant.

Noise impacts associated with the Alternative Site #1 location are expected to be similar to the proposed action impacts. The presence of background noise, construction and operations noise, and the lack of a substantial number of receptors are the same for both project locations.

4.2.4.2 ALTERNATIVE SITE #2

Same as Alternative Site #1 — negligible difference between Site #2 and the proposed action site.

4.2.4.3 ALTERNATIVE SITE #3

Same as Alternative Site #1 — negligible difference between Site #3 and the proposed action site.

4.2.5 BIOLOGICAL RESOURCES

4.2.5.1 ALTERNATIVE SITE #1

Numerous adverse impacts (some of which are potentially significant) have been identified in the project area which apply to Alternative Site #1. Potential impacts include vegetation removal, habitat loss, soil compaction, and loss or displacement of animals (especially desert tortoise). A variety of mitigation measures have been proposed to address the impacts, and no significant impacts are expected to remain after mitigation measures are implemented.

The impacts and mitigation measures anticipated for Alternative Site #1 are similar to those associated with the proposed action site.

4.2.5.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts and mitigation to those described for Alternative Site #1. There is no substantive difference between the biological resource impacts and mitigation measures for Site #2 and those of the proposed action.

4.2.5.3 ALTERNATIVE SITE #3

Alternative Site #3 would have similar impacts and mitigation to those described for Alternative Site #1. There is no substantive difference between the biological resource impacts and mitigation measures for Site #3 and those of the proposed action.

4.2.6 LAND USE

4.2.6.1 ALTERNATIVE SITE #1

Adverse impacts associated with construction may occur due to conflicts with dispersed recreation use within the project site. Operations impacts may be adverse and potentially significant due to inconsistencies with County building height planning policies, but variances approved in conjunction with the project's Conditional Use Permit should mitigate this impact. Potentially significant adverse impacts may also occur if conflicts arise between proposed facilities and the research/educational activities associated with the Pisgah Lava Flow Research National Area; these impacts are expected to be mitigated to a less-than-significant level. Adverse closure impacts similar to those expected for construction would also be expected.

The impacts and mitigation measures associated with the Alternative Site #1 location are expected to be similar to those associated with the proposed action.

4.2.6.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts to those described for Alternative Site #1 above. There is a negligible difference between land use impacts of Alternative Site #2 and the proposed action.

4.2.6.3 ALTERNATIVE SITE #3

Alternative Site #3 would have similar impacts to those described for Alternative Site #1 above. There is a negligible difference between land use impacts of Alternative Site #3 and the proposed action.

4.2.7 VISUAL RESOURCES

4.2.7.1 ALTERNATIVE SITE #1

Potentially significant adverse impacts could occur due to the high visibility of the process plant, especially in relation to views of Pisgah Crater for eastbound viewers on I-40 and Highway 66. The contrast and visibility of the other project facilities (including the ore-body wells, piping, gypsum pond, water wells, and access road) of Alternative Site #1 would be considered an adverse impact. Due to their limited visibility, low contrast, and location in the Class III Visual Management Class (which allows noticeable contrasts), a significant adverse visual resource impact would not be expected. Construction impacts and closure impacts would be expected to be adverse due to visual character contrasts associated with equipment activities and storage/ maintenance areas, but impacts should not be significant.

The potentially significant adverse impacts associated with the Alternative Site #1 location would represent a substantial increase in project/landscape contrast in comparison to those anticipated for the proposed action site. Mitigation measures would be similar to those discussed for the proposed action.

4.2.7.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts to those described for the Alternative Site #1 above. Alternative Site #2 would have a slightly greater potential for significant impact than the proposed action and would require similar mitigation measures to those proposed for all alternative sites.

4.2.7.3 ALTERNATIVE SITE #3

Alternative Site #3 would also have similar impacts to those described for the Alternative Site #1, although the project would be less visible from I-40 than the other alternative sites due to the increased distance from the highway corridor. Alternative Site #3 would have a slightly greater potential for adverse significant impact than the proposed action and would require similar mitigation measures to those previously proposed.

4.2.8 TRANSPORTATION

4.2.8.1 ALTERNATIVE SITE #1

Adverse impacts are expected due to increases in construction, operation, and closure traffic, but due to the small incremental increase, the impacts are not expected to be significant.

Impacts associated with the Alternative Site #1 location are expected to be similar to the proposed action impacts.

4.2.8.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts to those described for Alternative Site #1 above. There is no anticipated difference between the transportation impacts of Alternative Site #2 and the proposed action.

4.2.8.3 ALTERNATIVE SITE #3

Alternative Site #3 would have similar impacts to those described for Alternative Site #1 above. There is no anticipated difference between the transportation impacts of Alternative Site #3 and the proposed action.

4.2.9 CULTURAL RESOURCES

4.2.9.1 ALTERNATIVE SITE #1

The majority of potential impacts would be expected during project construction. Impacts to be considered would include, but not necessarily be limited to, the destruction or displacement of cultural deposits and the loss of scientific information. Construction activities for Alternative Site #1 would impact the National Trails Highway, which would be considered an unavoidable adverse impact, and site CA-SBR-1505, which could be a significant impact if the site is deemed eligible for the National Register of Historical Sites. Mitigation to avoid significant cultural impacts would include avoidance, data recovery, and worker education, and is discussed in more detail in Section 4.1.9.4.

Based on areal disturbance of cultural resources, the adverse impacts and potential mitigations associated with the Alternative Site #1 location are expected to reflect a greater impact potential on cultural resources than that expected for the proposed action location.

4.2.9.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts and mitigations as those described for Alternative Site #1. The adverse impacts and potential mitigations associated with Site #2 are expected to reflect a greater impact potential on cultural resources than that expected for the proposed action location.

4.2.9.3 ALTERNATIVE SITE #3

Alternative Site #3 would have similar impacts and mitigations as those described for Alternative Site #1. The adverse impacts and potential mitigations associated with Site #3 are expected to reflect a greater impact potential on cultural resources than that expected for the proposed action location.

4.2.10 PALEONTOLOGICAL RESOURCES

4.2.10.1 ALTERNATIVE SITE #1

No scientifically significant paleontological resources have been found in the field surveys relating to the site, but there is a potential for significant adverse impacts related to the uncovering of resources during construction. The potential significance would be mitigated through spot checks of construction activities and required evaluations of unearthed resources at the time of uncovering.

The impacts and mitigations associated with the Alternative Site #1 location are expected to be similar to those for the proposed action.

4.2.10.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts to those described for Alternative Site #1 above. There is virtually no difference between the paleontological impacts of Site #2 and the proposed action.

4.2.10.3 ALTERNATIVE SITE #3

Alternative Site #3 would have similar impacts to those described for Alternative Site #1 above. There is virtually no difference between the paleontological impacts of Site #3 and the proposed action.

4.2.11 SOCIOECONOMICS

4.2.11.1 ALTERNATIVE SITE #1

Construction impacts would include beneficial impacts to local employment, tax revenues, and product sales. Demands on local infrastructure represent an adverse impact not considered significant due to the small scale of the public services and utility needs generated by the project. Operational and closure impacts are also expected to reflect minor beneficial impacts associated with the local economy, and adverse non-significant impacts to infrastructure and utility services.

The socioeconomic impacts associated with the Alternative Site #1 are expected to be similar to the proposed action.

4.2.11.2 ALTERNATIVE SITE #2

Alternative Site #2 would have similar impacts to those described for Alternative Site #1. There is no difference between the socioeconomic impacts of Alternative Site #2 and the proposed action.

4.2.11.3 ALTERNATIVE SITE #3

Alternative Site #3 would have similar impacts to those described for Alternative Site #1. There is no difference between the socioeconomic impacts of Alternative Site #3 and the proposed action.

4.2.12 SUMMARY

A comparison of impacts associated with the proposed action and the three alternative process plant site locations is summarized in Table 4.2-1. In general, there is a negligible difference between the impacts associated with the proposed action and the impacts associated with any of the alternative sites. Two resource areas (cultural and visual) would potentially reflect either increased adverse impacts or a less beneficial impact. In either situation, however, adverse impacts would not substantially change. As is the case for the proposed action, hydrology would remain the single resource area where significant impacts may be expected.

TABLE 4.2-1
SUMMARY IMPACT COMPARISON:
PROPOSED ACTION SITE AND ALTERNATIVE SITES

Discipline	Alternative Process Plant Site		
	1	2	3
Geology, Soils, Seismology	=	=	=
Hydrology	=	=	=
Air Quality	=	=	=
Noise	=	=	=
Biological Resources	=	=	=
Land Use	=	=	=
Visual Resources	—	—	—
Transportation	=	=	=
Cultural Resources	—	—	—
Paleontological Resources	=	=	=
Socioeconomics	=	=	=

Relative Comparison Key:
+ less adverse impact/more beneficial impact than proposed action.
= same adverse or beneficial impact as proposed action.
— more adverse impact/less beneficial impact than proposed action.

4.3 NO-ACTION ALTERNATIVE

Implementation of the No Action Alternative would mean that the Fort Cady Mining Project would not be developed. The present conditions and uses of the site would generally continue, including the high-voltage transmission line and natural gas pipeline corridors; dispersed recreation, and scattered geology/biology research associated with the lava flow. The land use classifications applicable to the project site would remain in force (Class M for BLM lands and Resource Conservation District for San Bernardino County lands), and the wide variety of existing uses allowed by the jurisdictions would continue in the future. The single substantial change to the existing site would occur as a result of the removal of the existing pilot project and the facilities associated with the operation. The removal of the building, ponds and drilling equipment would allow the site to revert back to a desert open space condition, and the Hector Mine would be left as the only active mining operation in the area (unless the lava aggregate mining operation at Pisgah Crater is reactivated).

Under the No Action Alternative, the adverse impacts identified with the proposed action would not occur, including potentially significant impacts associated with increased groundwater usage and land use conflicts with the proposed ACEC designation. In addition, the loss of the relatively small beneficial economic and employment impacts associated with the No Action Alternative is not expected to make a substantial difference in the overall regional economy. If the project were not developed, however, the potential for some reduction in the dependence of American manufacturers on foreign imports of boric acid would not exist, and the potential to increase foreign export of boric acid would not exist. Other benefits which would not be realized include the potential reduction of consumer costs for certain industrial products and the opportunity to establish a track record of the in-situ mining process for further use of the technique. Based on these considerations, the No Action Alternative would be less economically desirable than the proposed action.

Section 5.0

Unavoidable Adverse Environmental Effects

5.0 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

The potential environmental impacts that would result from implementation of the proposed project are discussed in Section 4.0. In most cases, impacts that have been identified would be adverse but not significant. In other instances, incorporation of the mitigation measures described in Section 4.0 would reduce the adverse impacts to a level of not significant. However, consumptive use of groundwater may result in exceedence of the safe yield of the aquifer. There are also land use issues associated with the compatibility of the proposed action and the proposed Pisgah Crater Area of Critical Environmental Concern designation. These would be significant unavoidable adverse impacts.

Section 6.0

Short-Term versus Long-Term Uses of the Environment

6.0 RELATIONSHIP BETWEEN LOCAL AND SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Implementation of the proposed action would necessitate short-term use of the environment during the lifetime of the project. Potential environmental impacts associated with the project are discussed in Section 4.0. Mitigation measures shall be included in the project (see Section 4.0) to minimize potential environmental impacts. At the end of the project's operational lifetime, equipment would be removed and ground surfaces restored to conditions as near to those that existed prior to the facility's construction as is practicable. As a result, there should be no decrease in potential beneficial uses of the environment. No significant long-term risks to health and safety are expected to result from implementation of the proposed action.

In summary, the short-term use of the environment necessary for the proposed action is not expected to result in significant long-term adverse impacts on the productivity of the environment.

Section 7.0

Significant Irreversible Environmental Changes

7.0 SIGNIFICANT IRREVERSIBLE ENVIRONMENTAL CHANGES

Irretrievable and irreversible commitments of natural resources that would result from this project include direct consumption of the colemanite ore body; fossil fuels used for transportation and processing of the boric acid; natural gas used to fire the cogeneration plant and produce the project's electricity. Given the relatively small scale of the project (even though it would be long-term), these impacts would be adverse but not significant.

The land requirements for the facilities would not necessarily represent an irreversible or irretrievable commitment of resources because the buildings could be removed and the land reclaimed to approximately its original condition at the end of the proposed action.

Section 8.0

Growth-Inducing Impacts of the Proposed Action

Section 9.0

Cumulative Impacts

9.0 Cumulative Impacts

9.1 PROJECTS WITHIN THE VICINITY OF THE PROPOSED ACTION

Six projects with the potential to produce cumulative impacts have been identified within the vicinity of the proposed action. These projects are identified and described below.

HECTOR MINE EXPANSION

The Hector Mine, owned and operated by Rheox, Inc., has been in operation for over 50 years. This mining operation is located 16 miles east of Newberry Springs, approximately one mile from the proposed Fort Cady project. Rheox, Inc. is proposing an enlargement of its existing facilities by approximately 140 acres in order to accommodate the expansion of three overburden stockpiles and an active open pit. The Hector Mine is expected to be in operation until 2031, and the proposed expansion would take place in four phases, each consisting of the addition of between approximately 25 and 60 acres. A fleet of approximately 25 trucks would leave the facility several times per week to deliver ore to the Newberry Springs processing facility. The route taken for these deliveries would be the National Trails Highway. Three or four times per year, approximately 25 trucks would deliver ore to the Hector railroad siding for shipment.

This expansion has been approved by the BLM and the County of San Bernardino.

BROADWELL DRY LAKE HAZARDOUS WASTE REPOSITORY

The Broadwell Corporation is proposing to construct and operate the Broadwell Basin Residuals Repository (BBRR), an above-ground hazardous waste facility, approximately 12 miles northeast of the proposed Fort Cady project. The operational lifetime of this landfill would be approximately 30 years, with an average of 2,000 tons of waste accepted per day. At build-out, the facility would cover 977 acres. Approximately 160 trucks would enter and leave the facility per day, and approximately 40 people would be employed at the facility. The proposed treatment would result in the stabilization of the landfilled waste, which would minimize the leaching potential of contaminating metals.

This project is currently under environmental review, and an EIS/EIR is being prepared to address potential environmental impacts of the project.

HIDDEN VALLEY RESIDUALS REPOSITORY

Hidden Valley Resources, Inc. is proposing to construct and operate the Hidden Valley Residuals Repository (HVRR), also a hazardous waste facility, located approximately eight miles north of the proposed Fort Cady project. The waste would be landfilled in underground storage areas, which would be developed in phases, at a rate of approximately five to ten acres per year. At build-out, the facility would cover a total of 1,300 acres. Approximately 30 to 50 railcar loads and 10 to 15 truckloads of waste would be landfilled at the facility per day, and the operational lifetime of this project would be 120 years.

This project is currently under environmental review, and an EIS/EIR is being prepared to address potential environmental impacts of the project.

NAVAL FACILITIES ENGINEERING COMMAND TACTICAL VEHICLE TRAIL

The Western Division of the Naval Facilities Command is proposing to utilize an ungraded tank trail, which would extend from the Twenty-Nine Palms Marine Corps Air-Ground Combat Center to the railhead at Manix, California. This trail, as currently proposed, would extend through the Fort Cady project area. The purpose of the trail would be to provide access for the practice of tactical vehicular marches and maneuvers ranging in size from one to several hundred vehicles. The larger maneuvers could take place within a time period of up to two weeks. In addition, this trail would enable personnel from Twenty-Nine Palms to train in conjunction with personnel from Fort Irwin. The proposed ungraded trail would be 25 miles long and 100 meters wide and would include two 20-acre vehicle staging areas.

An EIS/EIR is in the process of being prepared to address potential environmental impacts of the project.

AMBOY RAIL-CYCLE WASTE MANAGEMENT FACILITY

The Rail-Cycle joint venture, comprised of Waste Management of North America, Inc. and the Atchison Topeka & Santa Fe Railroad, is working to site, design, construct, and operate an above-ground Class III landfill near Amboy, California, approximately 65 miles east of the proposed Fort Cady project. The facility would be sited on approximately 4,480 acres, 1,900 of which would be used for landfilling. The landfill would have an operational lifetime of 60 to 100 years and would accommodate up to 21,000 tons of solid waste per day, for a total of 400 to 500 million tons. Approximately 50 people would be employed in the operation of the facility at build-out. This project is in the early planning stages. Scoping meetings would be held and an EIS/EIR would be prepared.

PISGAH MINING OPERATION (TWIN MOUNTAIN MINE)

Although the Pisgah Mining Operation (Twin Mountain Mine) has generally been inactive for several years, the operation may resume activities during the period that the proposed project would be active; therefore this project is included in the cumulative analysis.

9.2 POTENTIAL CUMULATIVE IMPACTS OF THE PROPOSED ACTION AND PROJECTS WITHIN THE VICINITY

Although the impacts from individual new projects in an area might be minor, the cumulative impacts from all of the new projects in an area could be significant. A discussion of potential cumulative impacts associated with the proposed action and other projects within the vicinity is presented below.

9.2.1 GEOLOGY

The proposed action and each of the projects mentioned above would involve topographical alteration of the land on which they are sited and an increase in erosion potential. The proposed action, the Hector Mine, the BBRR, the HVRR, and the tank trail would involve relatively minor topographical alteration. The Amboy landfill, and possibly the Twin Mountain Mine, however, would involve a relatively large area of topographic alteration. A potentially significant adverse cumulative impact to topography as a result of increased erosion could result from the seven projects, but it is expected that this impact would be fully mitigated and would be rendered not significant as the result of required reclamation efforts.

9.2.2 HYDROLOGY

The proposed action and each of the projects mentioned above would involve the use of groundwater resources to satisfy the water demands of the project and could potentially lead to a state of overdraft on the underlying aquifer. This would contribute to the diminishment of a relatively rare desert resource, a potentially significant adverse cumulative impact.

9.2.3 CLIMATE AND AIR QUALITY

The proposed action and each of the projects mentioned above would contribute to a increase in emissions, especially of NO_x and PM_{10}, in the Southeast Desert Basin. This could result in a potentially significant adverse cumulative effect on air quality in the region. However, the seven projects are relatively widely separated, which would lead to dispersion of air emissions. In addition, each of the seven projects is subject to the permit requirements of the San Bernardino County APCD. Therefore, it is expected that the projects would not be approved without air quality controls, and no significant adverse cumulative impacts to air quality are expected.

9.2.4 NOISE

The proposed action and each of the projects mentioned above would involve the generation of some noise. However, the BBRR, the HVRR, and the Amboy Landfill are far enough away from the proposed action so that cumulative noise impacts are not likely. The proposed action is, however, within close proximity of the Twin Mountain Mine, Hector Mine and the tank trail; therefore, the potential for cumulative adverse noise impacts exists within this area. However, these impacts would not be considered significant, due to the absence of off-site sensitive noise receptors within the vicinity.

9.2.5 BIOLOGICAL RESOURCES

The proposed action and each of the projects mentioned above would involve the loss of vegetation, the reduction in available habitat for non-sensitive species of wildlife, and the displacement or loss of non-sensitive species of wildlife. However, these cumulative adverse impacts would not be considered significant, since large areas of similar vegetation and available habitat exist adjacent to each of the projects. The seven projects could also lead to a loss of desert tortoise habitat. However, current regulations require habitat compensation at a rate established by the BLM, and this habitat compensation is expected to render the potential adverse cumulative impact to tortoise habitat not significant.

9.2.6 LAND USE / RECREATION

The proposed action and each of the projects mentioned above are well removed from developed areas. The project's land uses have not and are not expected to result in incompatibility with existing land uses under current plans. However, there may be adverse cumulative impacts and land use incompatibilities from past and future area activities on the proposed Pisgah Crater ACEC designation, if approved, not all of which may be mitigated.

9.2.7 VISUAL RESOURCES

Because most of the seven projects are widely spaced, a cumulative impact to visual resources is not expected. The proposed action would be within potential visual contact with the Twin Mountain Mine, Hector Mine and the tank trail. However, since possible Twin Mountain Mine restoration and the Hector Mine expansion would occur in an area that is already disturbed, and the tank trail would create a relatively small area of disturbance, and a limited number of off-site sensitive visual receptors will view in the area, no significant adverse cumulative impacts to visual resources are expected.

9.2.8 TRANSPORTATION

The proposed action and most of the projects mentioned above would (all except the Hector Mine expansion) involve increasing traffic on Interstate 40. However, since this route is currently not heavily utilized, sufficient capacity exists to accommodate the increased traffic generated. Therefore, no significant adverse cumulative impacts to transportation are expected.

9.2.9 CULTURAL RESOURCES

The seven projects have the potential to result in significant adverse cumulative impacts to cultural resources. However, cultural resources are currently afforded substantial legal protection, and impacts to these resources are required to be mitigated through avoidance or through data recovery programs. Therefore, significant adverse cumulative impacts to cultural resources are not expected.

9.2.10 PALEONTOLOGICAL RESOURCES

The seven yprojects have the potential to result in significant adverse cumulative impacts to paleontological resources. However, as with cultural resources, paleontological resources are currently afforded substantial legal protection. Impacts to these resources are required to be mitigated through avoidance or through data recovery programs. Therefore, significant adverse cumulative impacts to paleontological resources are not expected.

9.2.11 SOCIOECONOMICS

The proposed action and each of the projects mentioned above would be located in relatively isolated areas and would not place a significantly increased demand on the existing infrastructure in those areas. The seven projects would result in a minor increase in the amount of employment in the region and an increase in property tax revenues to the County. The projects could also contribute to sustaining the local economy and perhaps provide for a small amount of economic growth. These cumulative impacts would be considered beneficial. Potential adverse cumulative impacts would include a small amount of population growth and associated housing demand in the region. However, because of the relatively small scale of these cumulative adverse impacts to socioeconomics, they are not considered significant.

Section 10.0

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10.0 References

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Section 11.0

Consultation and Coordination

11.0 CONSULTATION AND COORDINATION

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Section 12.0

Acronyms

12.0 ACRONYMS

ADT	(annualized) Average Daily Total (re: vehicles)
APCD	Air Pollution Control District
AQMD	Air Quality Management District
ARB	(California) Air Resources Board
AT&SF	Atchison, Topeka and Santa Fe Railroad
B.P.	Before the Present (re: prehistory; e.g., 2,000 B.P.)
BBRR	Broadwell Basin Residuals Repository
BCC	Barstow (Area) Chamber of Commerce
bgs	below ground surface
BLM	Bureau of Land Management
BPD	(City of) Barstow Planning Department
CAAQS	California ambient air quality standards
CADF	California Department of Finance
CCAA	California Clean Air Act
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game
CDMG	Conservation Division of Mines and Geology
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CNPS	California Native Plant Society
CO	carbon monoxide
Db	decibel(s)
dBa	A-weighted decibels (rated to account for human sensitivity to noise)
DCSD	Daggett Community Service District
DWR	(State of California) Department of Water Resources
EA	Environmental Assessment
EDD	(California) Employment Development Department
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	(United States) Environmental Protection Agency
FCMC	Fort Cady Mineral Corporation
FER	Fault Evaluation Report
FLPMA	Federal Land Policy and Management Act (1976)
FY	Fiscal Year
HVRR	Hidden Valley Residuals Repository

kV	kilovolt
kW	kilowatt
MCE	maximum credible earthquake
md	millidarcies
mg/L	milligrams per liter
MMBTU	one million British Thermal Unit(s)
MOU	Memorandum of Understanding
MPE	maximum probable earthquake
mph	mile(s) per hour
MSA	(Riverside-San Bernardino) Metropolitan Statistical Area
MSCF	one thousand standard cubic feet
MSL	mean sea level
MW	megawatt(s)
NAAQS	National ambient air quality standards
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NO_2	Nitrogen dioxide
NOI	Notice of Intent
NOP	Notice of Preparation
NO_x	oxides of nitrogen
NSCSD	Newberry Springs Community Services District
NSR	New Source Review Net Emission Increases
O_3	Ozone
PCP	Pilot-Commercial Plant
PGT	Pacific Gas Transmission
PG&E	Pacific Gas & Electric Company
PM_{10}	10 microns in diameter
ppb	parts per billion
ppm	parts per million
RC	Rural Conservation (District)
ROG(s)	reactive organic gas(es)
RWQCB	Regional Water Quality Control Board
SBBM	San Bernardino Base and Meridian
SBCAPCD	San Bernardino County Air Pollution Control District
SBPD	San Bernardino (County) Planning Department
SCAG	Southern California Association of Governments
SCE	Southern California Edison Company

SDAB	Southeast Desert Air Basin
SHPO	State Historic Preservation Officer
SMARA	(California) Surface Mining and Reclamation Act
SO_2	Sulfur dioxide
TDS	Total Dissolved Solids
U.S.C.	United States Code
ug/m^3	micrograms per cubic meter
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VRM	Visual Resource Management

Section 13.0

Glossary

13.0 GLOSSARY

Acid — Any compound that can react with a base to form a salt

Aquifer — A body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs

Blowdown — The steam that comes off the boiler unit of an electrical generator

Baghouse — A building that houses various chambers and filters, and which is used to filter out fine particulates from a forced-air stream

Boric acid — A white crystalline compound (H_3BO_3) with the properties of a weak acid, used as a mild antiseptic and in the manufacture of cements, enamels, etc.

Boron — A nonmetallic chemical element occurring only in combination, as with sodium and oxygen in borax, and produced in the form either of a brown amorphous powder or very hard, brilliant crystals; its compounds are used in the preparation of boric acid, water softeners, soaps, enamels, glass, pottery, etc.

CEQA — California Environmental Quality Act. Policies enacted in 1970, and subsequently amended, the intent of which is the maintenance of a quality environment for the people California now and in the future

Cogeneration — A way of generating electricity such that heat/steam, which is a byproduct of combustion, is used for another industrial process that requires heat/steam, rather than emitting it to the atmosphere

Colemanite — A hydrous borate of calcium

Discharge — Rate of flow at a given instant in terms of volume per unit of time; in groundwater use, the movement of water out of an aquifer

Drawdown — A lowering of the water level to supply industry with water

EIR/EIS — A joint environmental document prepared to satisfy the requirements of both the California Environmental Quality Act and the National Environmental Quality Act

Elutriation — Purification by washing and straining

Environment — The physical conditions which exist within the area which will be affected by a proposed project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance. The area involved shall be the area in which significant effects would occur either directly or indirectly as a result of the project. The *environment* includes both natural and manmade conditions.

Groundwater — Water found beneath the land surface, in the zone of saturation below the water table

Groundwater basin — Underground formation with sides and bottom of relatively impervious material in which groundwater is held or retained; aquifer or system of aquifers with well defined boundaries

Mitigation measure — Method or procedure undertaken for the purpose of avoiding or reducing potential impact(s) of an action

NEPA — National Environmental Policy Act. Federal 1969 legislation which encourages restoration and maintenance of environmental quality to the overall welfare of living things

Project — The whole of an action, which has a potential for resulting in a physical change in the environment

Ore body — A body of minerals from which a metal can be extracted

Right-of-way — The right to pass over property owned by another on, or within which, facilities may be built

Sump — A pit or pool at the bottom of a shaft or mine, in which water collects and from which it is pumped; an excavation at the head of a tunnel or shaft

Slurry — Material used for backfilling

APPENDIX A:

NOTICE OF INTENT

authorizations granted by the Bureau of Land Management.

This closure shall remain in effect until further notice.

EFFECTIVE DATE: May 15, 1991.

FOR FURTHER INFORMATION CONTACT: Jack Albright, BLM Baker Resource Area, P.O. Box 987, Baker City, Oregon 97814, 503-523-6391.

Jack D. Albright,
Area Manager.
[FR Doc. 91-11115 Filed 5-9-91; 8:45 am]
BILLING CODE 4310-33-M

[CA-060-01-4130-15]

Intent to Prepare an EIS for the Proposed Fort Cady Project

AGENCY: Bureau of Land Management Interior.

ACTION: Notice of intent.

SUMMARY: The Barstow Resource Area, Bureau of Land Management, California Desert District, in coordination with the County of San Bernardino, will prepare a joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for a mining operation proposed by Fort Cady Minerals Corporation (FCMC). This document will meet the requirements of both the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

The applicant, FCMC, proposes to construct and operate an in-situ solution borate mine and processing plant on their leased mining claims, in addition to lands belonging to the State of California, and lands leased from Southern California Edison Company and the Southern Pacific Land Company. The proposed Fort Cady Project is located approximately 38 miles east-southeast of Barstow, California near Pisgah Crater. The proposed mine and processing facilities would ultimately affect approximately 945 acres.

The EIS/EIR will assess the impacts of in-situ solution mining, construction and operation of the mine, processing plant, and solar evaporation ponds, construction and maintenance of access roads and rail spur, development of a water well system, and reclamation of disturbed lands.

In addition, the EIS/EIR will consider alternative technologies and alternate siting of components, including access roads and rail spur, solar evaporation ponds, processing facilities, and water wells.

The EIS/EIR will consider the following general issues: water resources (specifically, the potential for reduction in quantity of ground water, potential for contamination, or other changes to quality of ground and surface water and the potential for alteration of flood flows), wildlife resources, botanical resources, cultural resources, geologic hazards (including the potential for seismic activity due to changes in the geologic substructure), soils, changes to existing and potential land uses and transportation, visual resources, air quality, hazardous and solid waste (specifically, the potential for chemical and hazardous substance spills or discharges), socioeconomic and public safety issues, and cumulative impacts.

PUBLIC PARTICIPATION: Three public scoping meetings will be conducted prior to preparation of the EIS/EIR in order to receive public comments, concerns, and interests which will be addressed in the document.

Date, Time, and Location:

May 30, 1991—7 p.m.: Newberry Springs Community Building, 30884 Newberry Road, Newberry Springs, California 92365.

May 31, 1991—7 p.m.: Barstow Station Inn, 1505 East Main Street, Barstow, California 92311.

June 1, 1991—1 p.m.: San Bernardino County Government Center, Board Hearing Chambers, 385 N. Arrowhead Avenue, San Bernardino, California.

FOR FURTHER INFORMATION CONTACT: Michael E. Ford, Project Lead, Bureau of Land Management, Barstow Resource Area, 150 Coolwater Lane, Barstow, California 92311 (619) 256-3591.

Dated: May 3, 1991.

Daryl Albiston,
Acting Area Manager.
[FR Doc. 91-11116 Filed 5-9-91; 8:45 am]
BILLING CODE 4310-40-M

[CA-060-01-4410-04-ADVB]

Meeting of the California Desert District Grazing Advisory Board

SUMMARY: Notice is hereby given, in accordance with Public Laws 92-463 and 94-579, that the California Desert District Grazing Advisory Board to the Bureau of Land Management, U.S. Department of the Interior, will meet Tuesday, May 14, 1991, from 9:00 a.m. to 4:30 p.m., in the California Desert Information Center, 831 Barstow Road, in Barstow, California.

The agenda for the meeting will include:

—Range management perspectives by Resource Area;
—Grazing management in riparian areas;
—Development of rangeland improvements;
—Review status of allotment management plans;
—Field review of sheep grazing operations;
—Update on sheep and cattle Section 7 consultation packages.

The meeting is open to the public, with time allotted for public comment after each agenda subject has been presented. Written comments are also accepted at the time of the meeting and will be incorporated into the minutes. During the afternoon portion of the meeting, Board members will participate in a field trip south of Barstow to view and discuss sheep grazing practices.

Summary minutes of the meeting will be maintained in the California Desert District Office, 6221 Box Springs Boulevard, Riverside, California 92507, and will be available for public inspection during regular business hours—8:00 a.m. to 4:30 p.m. (PDT)—within 30 days following the meeting.

FOR FURTHER INFORMATION CONTACT: Bureau of Land Management, California Desert District Office, Larry Morgan, 6221 Box Springs Boulevard, Riverside, California 92507, (714) 653-1359.

Dated: May 1, 1991.

Gerald E. Hillier,
District Manager.
[FR Doc. 91-11297 Filed 5-9-91; 8:45 am]
BILLING CODE 4310-40-M

[NV-930-91-4212-11; N-42002]

Termination of Recreation and Public Purpose Classification and Order Providing for Opening of Land; Nevada

April 8, 1991.

AGENCY: Bureau of Land Management, Interior.

ACTION: Classification termination and opening order.

SUMMARY: This notice terminates recreation and public purpose classification N-42002 in its entirety. The land will be opened to the public land laws generally, including the mining laws.

EFFECTIVE DATE: Termination is effective with the publication of this document. The land will be open to entry at 10 a.m. on June 10, 1991.

FOR FURTHER INFORMATION CONTACT: Vienna Wolder, BLM, Nevada State Office, 850 Harvard Way, P.O. Box 12000, Reno, NV 89520, (702) 785-6528.

SUPPLEMENTARY INFORMATION: Pursuant to the Recreation and Public Purposes Act (43 U.S.C. 869 et seq.), recreation

APPENDIX B:

NOTICE OF PREPARATION

D MANAGEMENT DEPARTMENT

JAN [illegible] 1991

COUNTY OF SAN BERNARDIN
ENVIRONMENTAL
PUBLIC WORKS AGENCY

rth Arrowhead Avenue • San Bernardino, CA 92415-0180 • (714) 387-4091

Date: January 4, 1991

To: Responsible and Trustee Agencies

Subject: NOTICE OF PREPARATION OF A JOINT ENVIRONMENTAL IMPACT REPORT/ENVIRONMENTAL IMPACT STATEMENT FOR THE FORT CADY MINERAL CORPORATION'S IN-SITU SOLUTION MINE APPROXIMATELY 1/2 MILE SOUTH OF THE INTERSECTION OF STATE HIGHWAY 40 AND HECTOR ROAD IN THE COMMUNITY OF NEWBERRY SPRINGS.

The San Bernardino County Planning Department will be coordinating with the Bureau of Land Management in the preparation of a joint Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) for the Fort Cady Mineral Corporation's in-situ solution mine approximately 1/2 mile south of the intersection of State Highway 40 and Hector Road. The Bureau of Land Management will be the Lead Agency in preparing the EIR/EIS and will conduct public scoping meetings in connection with the preparation of this document.

The project is a Conditional Use Permit/Mining and Reclamation Plan to establish a solution mine on 945.2 acres to extract 90,000 tons of boric acid annually. The total acreage for the Conditional Use Permit is split into the following areas of jurisdiction: Federal (5,330 acres), State (270 acres), and County (1,000 acres). The reclamation Plan for the entire project site falls under County jurisdiction.

The Environmental Initial Study, completed November 21, 1990 identified the following areas of potentially significant impact: 1) Geologic Hazards, 2) Hazardous Materials, 3) Biological Resources, 4) Cultural Resources, and 5) Water Supply/Water Quality.

This letter is a request for environmental information that you or your organization feels should be addressed in the Environmental Impact Report. Due to time limits, as defined by the California Environmental Quality Act, your response should be sent at the earliest possible date, but no later than 30 days after receipt of this notice. Comments and questions can be directed to Renee Mosher at the address above.

Sincerely,
PLANNING DEPARTMENT

RENEE MOSHER, PLANNER
ENVIRONMENTAL TEAM

Attachment: Initial Study and Location Map

SAN BERNARDINO COUNTY
INITIAL STUDY ENVIRONMENTAL CHECKLIST FORM

This form and the descriptive information in the application package constitute the contents of Initial Study pursuant to County Guidelines under Ordinance 3040 and Section 15063 of the State CEQA Guidelines.

I.

DATES ID :745DSN90006652SAMR01/06652SM1
COMMUNITY :NEWBERRY SPRINGS
[illegible]

APPLICANT :FORT CADY MINERAL CORP
PROPOSAL :MINING/RECLAMATION PLAN FOR EXISTING BORIC ACID OPERATION ON 578.20 AC

LOCATION :APPROXIMATELY 1/2 MILE SOUTH OF THE INTERSECTION OF HWY 40 & HECTOR RD
REP('S) :LILBURN CORPORATION C/O STEVE OR MARTY

USGS Quad: CADY MOUNTAINS SUNSHINE PEAK

T,R,Section: T8N R5E sec 21,22,23, 24,25,26,27,28,34,35, 36; T8N R6E sec 19, 20,30

Thomas Bros: 710 J-0 & K-0 711 A-0

Planning Area: CADY MTS

OLUD: RC

Improvement Level: 5

PROJECT CHARACTERISTICS: The project is a Mining and Reclamation Plan to construct and operate an in-situ solution mine and processing plant on both unpatented mining claims managed by the Bureau of Land Management and Fort Cady's patented mining claims, as well as lands belonging to the State of California. The proposed operation would produce 90,000 tons of boric acid annually. The proposed action would consist of drilling an initial 250 wells to a depth of 1600 feet to extract a solution of boric acid and calcium chloride from the orebody. In the longer term, new wells would be drilled to replace those which have depleted the reserves in that location. No wells are to be placed within the 735 foot wide transmission line corridor of the Southern California Edison Company.

The entire facility would encompass a total area of 945.2 acres. This would include 250 solution wells over an area of 372.6 acres (well separation would be 100 feet), 484 acres of solar evaporation ponds, a 13.8 acre processing facility, a 58.6 acre gypsum deposition area, a 13.2 acre ditch area, and 23 acres for a proposed railway/access road through the project area.

ENVIRONMENTAL/EXISTING SITE CONDITIONS: The project site, approximately 17 miles east of Newberry Springs, is currently vacant and undeveloped. However, a small portion of the property was used to establish a pilot program which consisted of a processing building, evaporation ponds, wells, several storage tanks and access roads. The area is characterized by low relief hills and hummocks of basaltic lava surrounded by Quaternary alluvial sands and gravels. The area supports a creosote bush scrub community dominated by creosote, burro bush, and cheesebush.

	EXISTING LAND USE	OFFICIAL LAND USE DISTRICT	IL
North	vacant	RC	5
South	N.L./Rheox mine	RC	5
East	vacant	RC	5
West	vacant	RC	5

II. Identification of maximum potential environmental effects of the proposed project. The purpose is to identify any potentially significant impacts and discuss mitigation measures for identified impacts. Please substantiate your responses by summarizing your assessment of significant impacts and referencing documents used as research (e.g., Norton Air Force Base AICUZ study re: Noise). Include quantification of changes caused by the project's development at maximum potential buildout from existing status.

Circle or underline specific item of concern for "yes" or "maybe" answers if one item applies and others do not. If an impact that would be significant can be mitigated below a level of significance, indicate by checking "yes" or "maybe" with an "-->" to "no" and discuss mitigative measure(s) under substantiation. Substantiation is also necessary for "no" answers.

NATURAL HAZARDS

	Yes	Maybe	No
1. Geologic Hazards. Will the proposal result in significant impacts related to:			
a. Unstable earth conditions or changes in geologic substructures?		X	
b. Change in topography or ground surface relief features?	X		
c. The destruction, covering or modification of any unique geologic or physical features?			X
d. Exposure of people or property to geologic hazards, such as earthquakes, landslides, mudslides, ground failure, or similar hazards?		X	
e. Exposure of people or property to water-related seismic hazards such as seiche?			X

SUBSTANTIATION (check X if project is located in the Geologic Hazards Overlay District): The project is located within an Alquist-Priolo Special Study Zone area. There may be some impact to the facility due to possible earthquake activity in the area. The geological study submitted by the applicant addressed the types of soils in the site, but did not address seismic activity and its effect on the project. A full geotechnical study evaluating this impact should be conducted as part of the EIR and mitigation measures proposed.

The project would create new surface relief features and other topographical changes. Reclamation of the site at completion of mining will include backfilling evaporation ponds, ripping and recontouring roads and building pads, and ensuring 2:1 slopes on the gypsum deposition area.

	Yes	Maybe	No
2. **Flood Hazards.** Will the proposed project result in significant impacts related to:			
a. Changes in currents, or the course of direction of water movements?	___	___	X
b. Changes in deposition, erosion, or siltation that may modify the channel of a river, stream, bay, inlet, or lake?	___	___	X
c. Alterations to the course or flow of flood waters?	___	X -->	X
d. Change in the amount of surface water in any water body?	___	___	X
e. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?	___	___	X
f. Exposure of people or property to water-related hazards such as flooding or dam inundation?	___	___	X

SUBSTANTIATION (check if project is located in the Flood Plain Safety Overlay District ___ or Dam Inundation Overlay ___): The project site is crossed by blue line streams, as identified on the USGS Quad map for the area. The project may have an impact upon these streams. The Department of Fish and Game should be contacted to determine the extent of the impact and to obtain the appropriate permits.

	Yes	Maybe	No
3. Fire Hazards. Will the proposed project result in significant impacts related to:			
a. Exposure of people or property to wildland fires?	___	___	X

SUBSTANTIATION (check ___ if project is located in the Fire Safety Overlay District): The project is not located within the Fire Safety Overlay District and occurs within an area of sparse vegetative cover. The wildland fire hazard is low.

	Yes	Maybe	No
4. Wind/Erosion. Will the proposed project result in significant impacts related to:			
a. Any increase in wind or water erosion of soils, either on or off the site?	___	X —>	X

SUBSTANTIATION: The project will generate some fugitive dust through construction and reclamation of the site, as well as use and maintenance of access and on site roads. Operator will be required to mitigate such impacts by applying dust binding agents on all on-site roads and work areas or though regular water spraying.

MANMADE HAZARDS

	Yes	Maybe	No
5. Noise. Will the proposed project result in significant impacts related to:			
a. Increases in existing noise levels?	___	___	X
b. Exposure of people to severe noise levels?	___	___	X

SUBSTANTIATION (check if the project is located in the Noise Hazard Overlay District ___ or is subject to severe noise levels according to the General Plan Noise Element ___): Due to the nature of the technology used and the remote area in which the project is located there will be no substantial impacts. Temporary noise disturbance will occur during construction activities. Non-significant noise increases will result to plant operations.

	Yes	Maybe	No
6. Aviation Safety. Will the proposed project result in significant impacts related to:			
a. Exposure of people to risk from aircraft operations?	___	___	X

SUBSTANTIATION (check X if project is located in the Airport Safety Overlay District): The project is located in the AR-4 Airport Safety Overlay District which indicates that there is a low level flight corridor over the project area. The project will not include any buildings exceeding 35 feet in height and will therefore not have an impact.

	Yes	Maybe	No
7. Hazardous/Radioactive Materials. Will the proposed project result in significant impacts related to:			
a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals, or radiation) in the event of an accident or upset conditions?		X	
b. Possible interference with an emergency response plan or an emergency evacuation plan?			X
c. Creation of any health hazard or potential health hazard?		X	
d. Exposure of people to potential health hazards?		X	

SUBSTANTIATION: The potential exists for a significant quantity of hazardous and solid waste material to be created, both as by-products of the operation and in the event of a chemical spill. These waste materials would include boric, hydrochloric and sulfuric acids, gypsum deposits, diesel and gasoline fuels, and evaporative pond discharges (unspecified chemical accumulations). Injecting acids into the subsurface creates the potential for localized chemical spills, which would be difficult to contain during emergencies. In addition, during periods of high rainfall, the potential for flooding exists. During these periods, any of the aforementioned chemicals or byproducts could be discharged onto the ground surface (overflowing the catchment basins) and become part of an uncontrolled hazardous waste/chemical spill. An EIR is required to address these issues and develop appropriate mitigation measures.

NATURAL RESOURCES

	Yes	Maybe	No
8. Biological Resources. Will the proposed project result in significant impacts related to:			
a. Loss, reduction, or deterioration of habitat and/or change in diversity of species of plants or animals?		X	
b. Reduction of the numbers of any unique, rare, threatened, or endangered species of plants or animals?		X	
c. Introduction of exotic species of plants or animals into an area, or in a barrier to the normal replenishment or migration of existing species?			X

SUBSTANTIATION (check if project is located in the Biological Resources Overlay _X__ or contains habitat for any species listed in the California Natural Diversity Database ____): The project is located in an area that has been identified by the Bureau of Land Management as potential Desert Tortoise habitat (Category 3, per Mike Ford, BLM). The Desert Tortoise has been placed on the Federal Threatened and Endangered Species List, therefore any impact to the Tortoise or its habitat is considered significant and should be fully evaluated in the EIR.

	Yes	Maybe	No
9. Cultural/Paleontological Resources. Will the proposed project result in significant impacts related to:			
a. The alteration or destruction of a prehistoric/historic archaeological site?		X	
b. Physical or aesthetic effects to a prehistoric or historic building, structure, or object?			X
c. A physical change that would affect unique ethnic cultural values?			X
d. Restricting existing religious or sacred uses within the potential impact area?			X
e. Any alteration or destruction of fossil remains?			X

SUBSTANTIATION (check if the project is located in the Cultural ____ or Paleontologic ____ Resources overlays or cite results of cultural resource review): Two archeological sites, both lithic scatters, have been recorded within the boundaries of the Fort Cady project area. Several additional sites have been recorded within the vicinity of the project area. Although the study area has never been systematically surveyed, available archeological data clearly indicated that the Fort Cady project area is located within a region that is archaeologically sensitive. These issues shall be addressed in the EIR and appropriate mitigation measures should be developed.

	Yes	Maybe	No
10. Air Quality. Will the proposal result in:			
a. Substantial air emissions or deterioration of ambient air quality?		X —>	X
b. The creation of objectionable odors?			X
c. Alteration of air movement, moisture or temperature, or any change in climate, either locally or regionally?			X

SUBSTANTIATION (discuss conformity with the South Coast Air Quality Management Plan, if applicable): The proposed project would generate some fugitive dust during construction and reclamation. Impacts to ambient air quality would be temporary and the operator would be required to implement dust suppression techniques. AQMD permits shall be required as conditions of approval. Vehicel emissions from employee traffic and truc, both service and material haulers, will make minor contributions to air quality degradation.

11. Water Supply/Water Quality. Will the proposed project result in significant impacts related to:

	Yes	Maybe	No
a. Changes in the quantity of groundwaters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations (onsite)?		X	
b. Substantial reduction in the amount of water otherwise available for public water supplies?		X	
c. Alteration of the direction or rate of flow of groundwaters?			X
d. Pollution, contamination, or any change in the quality of groundwater (toxics, nitrates, fluorides, salts, etc.)?		X	
e. Discharge into surface waters, or any alteration of surface water quality, including but not limited to, temperature, dissolved oxygen or turbidity?			X

SUBSTANTIATION: The nature of the technology that is proposed will utilize large quantities of water and may have a substantial impact on the local groundwater supplies in the area although these groundwater sources have been identified as being non-potable. The project will also generate considerable levels of discharge, from the use of hydrochloric acid and sulfuric acid in the processing, that may be released into the groundwater and will significantly impact the quality of the local groundwater. The impact of the project upon the quantity and the quality of the groundwater in the area should be evaluated in the EIR and mitigation measures proposed.

12. Open Space/Recreation/Scenic. Will the proposed project result in significant impacts related to:

	Yes	Maybe	No
a. The quality or quantity of existing recreational opportunities?			X

b. The obstruction of any scenic vista or view open to the public?	___	___	X
c. The creation of an aesthetically offensive site open to public view?	___	___	X
d. New light or glare?	___	___	X

SUBSTANTIATION (check ____ if project is located within the viewshed of any Scenic Route listed in the General Plan): The proposed project is not within the viewshed of any scenic corridor and any new lighting will be required to be directed on site.

13. Soils/Agriculture. Will the proposed project result in significant impacts related to:	Yes	Maybe	No
a. Disruptions, displacements, compaction, or overcovering of the soil?	___	___	X
b. Loss of agricultural soils?	___	___	X
c. Reduction in acreage of any agricultural crop?	___	___	X

SUBSTANTIATION (check ___ if project is located in the Important Farmlands Overlay): The project is not expected to cause any significant impacts to agricultural soils. This area is not conducive to commercial agriculture and no agricultural crops exist in the vicinity.

14. Mineral Resources. Will the proposed project result in significant impacts related to:	Yes	Maybe	No
a. Prohibit or restrict the development of any mineral resource rated as Classified or Designated by the State Mining and Geology Board?	___	___	X

SUBSTANTIATION (check ___ if project is located within the Mineral Resource Zone Overlay): The project proposes to utilize and develop the mineral resources available in the area and will therefore not have an adverse environmental impact on the use of mineral resources.

MANMADE RESOURCES

15/16. Utilities/Infrastructure. Will the proposal result in significant impacts related to a need for new systems, or substantial alterations to the following utilities:	Yes	Maybe	No
a. Power or natural gas?			X
b. Communications systems?			X
c. Water?			X
d. Sewer?			X
e. Storm water drainage?			X
f. Solid waste and disposal?			X

SUBSTANTIATION: The proposed mining activity is not expected to cause any significant impacts on utilities or infrastructure.

17. Transportation/Circulation. Will the proposed project result in significant impacts related to:	Yes	Maybe	No
a. Generation of substantial additional vehicular movement?			X
b. Effects on existing parking facilities, or demand for new parking?			X
c. Substantial impact upon existing transportation systems?			X
d. Alterations to present patterns of circulation or movement of people and/or goods?			X
e. Alterations to waterborne, rail or air traffic?	X	———>	X
f. Increase in traffic hazards to motor vehicles, bicyclists, equestrians, or pedestrians?			X

SUBSTANTIATION: The applicant proposes to contract with AT&SF railroad to create a spur onto the project site to allow for the efficient transfer of the product to the market. The rail road shall be contacted for conditions and/or permits that may be required for the encroachment. The proposal will not significantly alter or impact upon other existing transportation systems in the area. Traffic accessing the site will be utilizing the existing roadways and rail systems in the area.

		Yes	Maybe	No
18.	Energy. Will the proposed project result in significant impacts related to:			
a.	An increase in the rate of consumption of any natural resources?	___	___	X
b.	Use of substantial amounts of fuel or energy?	___	___	X
c.	Substantial increase in demand upon existing sources of energy, or require the development of new sources of energy?	___	___	X

SUBSTANTIATION: The project is not expected to create a substantial demand upon existing or create a need for additional energy sources.

		Yes	Maybe	No
19.	Housing/Demographics/Socioeconomics. Will the proposed project result in significant impacts related to:			
a.	An effect on existing housing, or creation of a demand for additional housing?	___	___	X
b.	Alteration of the location, distribution, density, or growth rate of the human population of the area?	___	___	X

SUBSTANTIATION: The project will not have significant effects upon the housing, demographics, or socioeconomics of the area. Employees are anticipated to commute from Newberry Springs and Barstow.

		Yes	Maybe	No
20.	Public Services. Will the proposed project result in significant impacts related to a need for new or altered governmental services in:			
a.	Fire protection?	___	___	X
b.	Police protection?	___	___	X
c.	Schools?	___	___	X
d.	Parks or other recreational facilities?	___	___	X

e. Maintenance of public facilities, including roads?	___	___	X
f. Other governmental services?	___	___	X

SUBSTANTIATION: The project will not have any significant impact on the above public services.

LAND USE

	Yes	Maybe	No
21. Will the proposed project result in significant impacts related to:			
a. A substantial alteration of the present or planned land use of an area? (Consider the Official Land Use Designation of the project site and surrounding property, as well as their Improvement Level designations on the General Plan Infrastructure Overlay and any relevant Resource Overlays.)	___	___	X

SUBSTANTIATION: The project area has a Land Use Designation of Resource Conservation (RC) and an Improvement Level of 5. Large portions of the site are managed by the Bureau of Land Management which allows mining of mineral resources on public lands subject to a Mining Plan of Operations. The RC District also allows mining subject to a Mining Conditional Use Permit/Reclamation Plan. The necessary infrastructure improvements as required by the Improvement Level 5 either already exist on site or will be provided by the applicant.

The project site is also in two Hazard Overlay Districts, Alquist-Priolo Special Study Zone and AR-4 Airport Safety Overlay. The potential geologic hazard from the Alquist-Priolo Zone should be fully evaluated in the EIR for the project. The risk from the AR-4 overlay is considered insignificant.

	Yes	Maybe	No
22. MANDATORY FINDINGS OF SIGNIFICANCE			
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below selfsustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	___	X	___
b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the			

environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.)	___	___	X
c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.)	___	X	___
d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	___	___	X

SUBSTANTIATION: The project proposal may impact on the habitat of the Desert Tortoise in the area. The Desert Tortoise has been placed on the Federal Threatened and Endangered Species List and any impact is considered significant.

The project has the potential to impact several resources including biological resources, groundwater quality and quantity, and surface streams. The project also may impact the geologic substructure in the area and may release hazardous materials into the ground or surface waters creating a potential health hazard. These impacts are all considered significant individually but cumulatively may be significant for the whole region and may limit the potential reuse of the site after reclamation.

III. Discussion of Environmental Evaluation:

The environmental review of the project has raised several issues which will require mitigation. An Environmental Impact Report is recommended to address the following issues:

1. The project is located in an Alquist-Priolo Study Zone. The impact of this development upon the geologic substructure shall be evaluated in the EIR through a full geotechnical study. The potential hazard due to seismic activity on the project and the hazardous materials used and stored on site should be thoroughly evaluated in the EIR.

2. The project will result in significant impacts related to release of hazardous substances in the event of an accident or upset conditions and the exposure of people to hazardous substances.

3. The project will result in a significant impact the habitat and range of the Desert Tortoise in the area. The Desert Tortoise has been listed as a Federally Threatened Species and any impact is considered significant. The impact on the tortoise shall be evaluated in the EIR and mitigation proposed.

4. The project will have a significant impact upon cultural/archeological resources on the site. The impact upon these resources shall be fully evaluated within the EIR.

5. The project will significantly effect both quality and quantity of the ground water in the area through the potential release of hazardous materials into the groundwater supply and through the use of water in the processing of the materials.

IV. Mitigation Measures to be included in project Conditions of Approval/ Mitigation Monitoring Program: Should the project be approved, the project's Conditions of Approval will include, but not be limited to, the following mitigation measures:

1. The Department of Fish and Game shall be contacted to determine the extent of impact on the blue-line streams on site. The applicant shall be required to comply with Fish and Game procedures and permitting requirements.

2. The applicant shall use dust preventive measures to keep soil from escaping the site as fugitive dust.

3. The applicant shall contact the AT & SF Railroad for appropriate permits and conditions for the addition of a railway spur to the site.

4. The applicant shall obtain the necessary AQMD permits to construct and operate.

Initial Environmental Evaluation Prepared By:

9-10-90
Date

Andrew J Rush
Signature Andrew J. Rush

On the basis of this initial evaluation:

The proposed project WOULD NOT have a significant effect on the environment, (and Mitigation Measures are included within the project's Conditions of Approval) and a NEGATIVE DECLARATION should be prepared. ☐

The proposed project MAY have a significant adverse effect on the environment, and an ENVIRONMENTAL IMPACT REPORT should be required. ☒

11-21-90
Date

Randy Scott
Signature

For The Planning Agency

REVISED 9/89

APPENDIX C:

BIOLOGICAL OPINION AND AMENDMENT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT
SOUTHERN CALIFORNIA FIELD STATION
2730 Loker Avenue West
Carlsbad, California 92008

October 29, 1992

Memorandum

To: State Director, Bureau of Land Management, Sacramento, California

From: Field Supervisor

Subject: Biological Opinion for the Fort Cady Project Mining Plan Proposal, San Bernardino County, California (3809 CAMC 20175 (CA-068.28)) (1-6-92-F-54)

This biological opinion responds to your request for formal consultation with the Fish and Wildlife Service (Service) pursuant to section 7 of the Endangered Species Act of 1973, as amended (Act). Your request for consultation was dated June 25, 1992, and received by us on June 29, 1992. At issue are the impacts that the development and operation of the Fort Cady Mining Plan Proposal may have on the desert tortoise (Gopherus agassizii), a federally listed threatened species.

This biological opinion was prepared using information: contained in your request for consultation to the Service's Regional Office in Portland, Oregon; obtained during informal consultation between our staffs; and contained in our files.

Biological Opinion

It is the opinion of the Service that the proposed project is not likely to jeopardize the continued existence of the desert tortoise. Critical habitat has not been proposed for this species in California. Therefore, critical habitat will not be adversely modified by the proposed action.

Description of the Proposed Action

The Fort Cady Minerals Corporation proposes to construct, own, and operate a boron mine and processing plant near Pisgah Crater, California. The proposed operation would produce gypsum and 90,000 tons of boric acid per year for an expected project life of 130 years. Project facilities would include a processing facility, water well field, 200 injection and extraction wells, a gypsum deposition area, and a railroad spur. The project area occupies approximately 7,000 acres, of which 368 would be disturbed by project operations. The Fort Cady Minerals Corporation leases mining rights from several companies and has several of its own claims in the area. The Fort Cady Minerals Corporation would also be required to obtain easements from the

Bureau of Land Management (Bureau) for the water line, access and utility corridors, and well sites. The project information contained in this biological opinion is from the biological assessment developed by Dames and Moore (1992).

The recovery of boron and gypsum would be accomplished by injecting a weak acid solution into the ore body through the solution wells. The same wells would then be used to extract the resulting solution, which would be processed on-site. The approximate area to be disturbed by the proposed action is as follows:

Well Field	273 acres
Process plant	10
Gypsum deposition area	27
Runoff interceptor ditch	8
Process water supply well network	20
Railroad spur and natural gas pipeline	10
Access roads	20
Total	368

Detailed descriptions of the construction and operation of the various components of the proposed action are contained in Dames and Moore (1992). The information contained in this biological opinion is intended only to describe specific actions that would adversely affect desert tortoises and their habitat.

The solution wells would be used to inject acid solution and withdraw raw materials for processing. As any of the 200 wells deplete the ore body in its immediate vicinity, the well would be dismantled and located over an unused portion of the well field. Acid and boron solutions would be moved to and from the well field by above-ground, eight-inch plastic trunk and lateral collector pipelines. Roads would be constructed throughout the well field to allow access. Fill dirt would be placed over lava in areas where blading of roads is not possible. The biological assessment does not discuss construction of a specific borrow site.

Extraction and purification of the minerals would occur within and adjacent to the processing plant, which would be a 600 by 400 foot building with concrete extensions totaling 340 feet in length at its ends. Power would be supplied by both a cogeneration facility located within the process plant and a 1.5-mile transmission line, linked to the existing Southern California Edison transmission line along Pisgah Crater Road. The transmission line would be located within the same right-of-way as the main access road to the site.

Other ancillary items include a main electrical substation, a process and fire water storage area, and a natural gas station. Sewage from the offices will be directed to a septic tank and tile bed system which would occupy an area of approximately 100 by 200 feet.

The gypsum would be deposited on a 27-acre area which would be dammed at both ends. An underground pipeline would convey the gypsum slurry to the deposition area. The Fort Cady Minerals Corporation also proposes to construct an interceptor ditch from its north dam to the west side of the well field to collect water that would normally flow into the deposition area. The ditch would be approximately 6,000 feet long and have an average depth of one foot.

Water supply wells would be located a maximum of approximately six miles from the processing facility. Water would be transported to the project area in above-ground delivery lines with a maximum size of four inches in diameter.

A 2.5-mile long railroad spur would be constructed from the process plant to the existing railroad to the northeast. A buried natural gas pipeline, approximately two miles in length, would be constructed between the plant and an existing gas line near Interstate 40. The gas line would parallel Pisgah Crater Road on the west side and follow the access road to the project site. Three access roads would be built for the proposed action. The road from Pisgah Crater Road to the process plant would be 1.6 miles long and 30 feet wide. The right-of-way for this road would also contain the natural gas pipeline, the electrical transmission line, and the railroad spur. The second access road would extend for 0.5 mile from the plant to the well field. Overhead transmission lines and solution pipelines would also be placed along this road, which would be 20 feet wide. The third access road would be 0.5 mile long and extend from the plant to the gypsum deposition area. A transmission line and several pipelines would also be contained in the same right-of-way. Employee traffic has been estimated at 130 vehicle trips per day.

The restoration plan primarily notes that wells would be capped, equipment removed, disturbed areas recontoured, and stockpiled soils redistributed. Access roads would be graded to blend with the surrounding terrain and the rail line would be removed. Unspecified revegetation plans would also be implemented.

The Bureau included measures to mitigate the impact of the proposed action with its request for consultation. These measures are:

1. The mine operator shall designate a field contact representative (FCR) who will be responsible for overseeing compliance with protective stipulations for the desert tortoise and for coordination on compliance with the Bureau. The FCR shall have the authority to halt all mining activities that are in violation of the stipulations. The FCR may be the mine operator, the mine manager, any other mine employee, or a contracted biologist.

2. An employee education program must be received, reviewed, and approved by the Bureau at least 15 days prior to the presentation of the program. The program may consist of a class or video presented by a qualified biologist (Bureau or contracted) or a video. Wallet-sized cards with important information for workers to carry are recommended. All mine employees shall participate in the desert tortoise education program prior to initiation of mining activities. The operator is responsible for ensuring that the education program is developed and presented prior to conducting activities. New employees shall receive formal, approved

training prior to working on-site. The program shall cover the following topics at a minimum:

- distribution of the desert tortoise,
- general behavior and ecology of the desert tortoise,
- sensitivity to human activities,
- legal protection,
- penalties for violations of State or Federal laws,
- reporting requirements, and
- project protective mitigation measures.

3. Only biologists authorized by the Service and the Bureau shall handle desert tortoises. The Fort Cady Minerals Corporation shall submit the name(s) of the proposed authorized biologist(s) to the Service for review and approval at least 15 days prior to the onset of activities. No mining activities shall begin until an authorized biologist is approved. Authorization for handling will be granted under the auspices of the Fort Cady Minerals Project section 7 consultation.

4. The authorized biologist shall be required on-site during the initial construction activities. This biologist shall have authority from the operator to halt any action that might result in harm to a desert tortoise.

5. The area of disturbance shall be confined to the smallest practical area, considering topography, placement of facilities, location of burrows, pubic health and safety, and other limiting factors. Work area boundaries shall be delimited with flagging or other marking to minimize surface disturbance associated with vehicle straying. Special habitat features, such as burrows, identified by the qualified biologist shall be avoided to the extent possible. To the extent possible, previously disturbed areas within the mining site shall be utilized for the stockpiling of excavated materials, storage of equipment, digging of slurry pits, location of office trailers, and parking of vehicles. The qualified biologist, in consultation with the project proponent, shall ensure compliance with this measure.

6. For mine development in desert tortoise habitat, the entire site shall be enclosed within a desert tortoise-proof fence. The fence shall be constructed under the direction of the authorized biologist or a Bureau compliance technician. The fence shall be located to avoid all desert tortoise burrows; to the extent possible, burrows will be placed on the outside of the exclosure. The fence shall be constructed of 1/2-inch mesh hardware cloth. It shall extend 18 inches above ground and 12 inches below ground. Where burial of the fence is not possible, the lower 12 inches shall be folded outward against the ground and fastened to the ground so as to prevent entry by desert tortoises. The fence shall be supported sufficiently to maintain its integrity. The fence shall be checked at least monthly and maintained when necessary by the mine operator to ensure its integrity. All desert tortoise-proof fencing shall be removed after site rehabilitation.

7. After fence installation, the authorized biologist shall conduct a thorough survey for desert tortoises within the mine site. All desert tortoises found shall be marked and removed from the exclosure and placed outside the nearest fence. If the removal is during the season of above-ground activity, the desert tortoises shall be placed beside a nearby burrow of appropriate size. If the removal is not in the season of above-ground activity, the desert tortoise shall be moved (dug out of burrow if necessary) on a seasonably warm day and placed at the mouth of a nearby burrow of appropriate size. If the desert tortoise does not enter the burrow, an artificial burrow may be needed. The authorized biologist shall be allowed some judgement and discretion to ensure that survival of the desert tortoise is likely.

8. Desert tortoises moved from within a fenced site shall be marked for future identification. An identification number using the acrylic paint/epoxy covering technique shall be placed on the fourth left costal scute (Fish and Wildlife Service 1990). 35-mm slide photographs of the carapace, plastron, and the fourth costal scute shall be taken. No notching is authorized.

9. Desert tortoises may be handled only by the authorized biologist and only when necessary. New latex gloves shall be used when handling each desert tortoise to avoid the transfer of infectious diseases between animals. Aside from the initial site clearance, any desert tortoise moved shall be placed in the shade of a shrub in the direction in which it was facing when found or at the entrance to a burrow if hibernating. In general, desert tortoises should be moved the minimum distance possible to ensure their safety.

10. The authorized biologist shall maintain a record of all desert tortoises encountered during mining activities. This information shall include for each desert tortoise:
    1) the locations (narrative and maps) and dates of observations;
    2) general condition and health, including injuries and state of healing and whether animals voided their bladders;
    3) location moved from and location moved to; and
    4) diagnostic markings (i.e., identification numbers or marked lateral scutes).

11. No later than 90 days after completion of construction activities, the FCR and authorized biologist shall prepare a report for the Bureau. The report shall document the effectiveness and practicality of the mitigation measures, the number of desert tortoises excavated from burrows, the number of desert tortoises moved from the site, the number of desert tortoises killed or injured, and the specific information for each desert tortoise as described in measure 10. The report shall make recommendations for modifying the stipulations to enhance desert tortoise protection or to make it more workable for the operator. The report shall provide an estimate of the actual acreage disturbed by various aspects of the operation.

12. Upon locating a dead or injured desert tortoise, the operator is to notify the Bureau. The Bureau must then notify the appropriate field office (Ventura) of the Service by telephone within three days of the finding. Written notification must be made within five days of the finding. The information provided must include the date and time of the finding or incident (if known), location of the carcass, a photograph, cause of death, if known, and other pertinent information. Desert tortoise remains shall be collected, delivered to the Bureau, and frozen as soon as possible. Injured animals shall be transported to a qualified veterinarian for treatment at the expense of the project proponent. If an injured animal recovers, the Service should be contacted for final disposition of the animal.

13. All trash and food items shall be promptly contained within raven-proof containers. These shall be regularly removed from the project site to reduce the attractiveness of the area to common ravens (Corvus corax) and other desert tortoise predators.

14. Structures that may function as common raven nesting or perching sites are not authorized except as specifically stated by the Bureau. The project proponent shall describe anticipated structures to the Bureau during initial project review.

15. At the end of the project, disturbed areas, including new access roads, shall be recontoured and reseeded with an appropriate mixture of native plant species according to Bureau specifications. After site rehabilitation, all desert tortoise-proof fence shall be removed.

16. The project proponent shall acquire sufficient off-site habitat lands to compensate for the unmitigated impacts of the project on the desert tortoise. The Bureau's compensation formula defined in Recommendations for the Management of the Desert Tortoise in the California Desert (1988) yields a compensation ratio of 4:1 for permanently disturbed acreage and a ratio of 2:1 for temporarily disturbed acreage associated with the proposed action. Therefore, desert tortoise habitat acreage totalling 1,480 acres shall be purchased by the Fort Cady Minerals Corporation and transferred to the Bureau. All compensation lands shall be within Bureau-designated Category I tortoise habitat within the West Mojave Region and shall be approved by the Bureau prior to satisfaction of this requirement. Acquisition of compensation lands shall be coordinated through the Bureau's California Desert District Realty Staff. Compensation requirements must be satisfied within one year of mining plan authorization.

Effects of the Proposed Project on the Listed Species

Species Account

On August 4, 1989, the Service published an emergency rule listing the Mojave population of the desert tortoise as endangered. In its final rule, dated April 2, 1990, the Service determined the Mojave population of the desert tortoise to be threatened. The Service is currently in the process of developing a recovery plan. Critical habitat has not yet been proposed.

The desert tortoise is a large, herbivorous reptile found in portions of the California, Arizona, Nevada, and Utah deserts. It also occurs in Sonora and Sinaloa, Mexico. Generally, desert tortoises are active during the spring and early summer when annual plants are most common. Additional activity occurs during warmer fall months and occasionally after summer rain storms. Desert tortoises spend the remainder of the year in burrows, escaping the extreme weather conditions of the desert.

Further information on the range, biology, and ecology of the desert tortoise can be found in Burge (1978), Burge and Bradley (1976), Hovik and Hardenbrook (1989), and Weinstein et al. (1987).

Approximately two-thirds of the project site is located on a bajada with numerous washes. Creosote bush (*Larrea tridentata*), bursage (*Ambrosia dumosa*), beavertail cactus (*Opuntia basilaris*), pencil cholla (*O. ramosissima*), and big galleta grass (*Hilaria rigida*) are common perennial species on this bajada. The remainder of the site is covered by lava flows with sparse vegetation.

Thirteen standard triangular transects were conducted to estimate the density of desert tortoises in the areas surrounding the project site. The plant site, well fields, gypsum deposition area, a 200-foot wide corridor centered on the access roads and main water line, and a 500-foot wide corridor centered on the railroad spur and access road were surveyed for desert tortoises using the Service's recommended 100 percent methodology.

Based on the number of sign detected, Dames and Moore (1992) rated desert tortoise densities as being from very low to very high as follows:

Range (number of desert tortoises per square mile)	Relative Density
0 - 10	Very low
10 - 45	Low
45 - 90	Moderate
90 - 140	High
140+	Very high

The solution well field, gypsum deposition site, and evaporation ponds were surveyed in October, 1990, by the Lilburn Corporation. The ponds and gypsum site were rated as supporting relatively low densities of desert tortoises and the solution well field was rated as moderate. These surveys were conducted prior to the heavy rains of March, 1991, after several years of drought. The Service has noted several instances where surveys conducted during the drought underestimated the numbers of desert tortoises. These results should be viewed with this information in mind.

The remainder of the desert tortoise surveys were conducted by Dames and Moore in February, 1992. These surveys indicated a patchy distribution of desert tortoises, ranging from areas of low to very high relative densities (Figure

1). The combined Lilburn and Dames and Moore surveys detected 363 corrected sign, including 7 live desert tortoises.

The biological assessment does not discuss the degree of existing disturbance on the site. However, a pilot operation for boron extraction was operated prior to 1989 and a processing plant remains on-site from that activity in the eastern portion of section 25. The existing Pisgah Crater cinder mine and Rheox mine are located in the immediate vicinity.

Analysis of Impacts

The proposed project would result in the take of desert tortoises which inhabit the plant facility, gypsum deposition area, pipeline and access rights-of-way, and well field sites. These impacts, including the loss of habitat within these areas, would occur during the construction phase of the proposed action. Additional desert tortoises could be taken if measures are not implemented to prevent animals from entering work areas, the rail line, and the access roads.

Approximately 368 acres of habitat would be destroyed by construction of project facilities. The area of the solution well field is estimated to be 273 acres. Habitat loss within the well field would likely be restricted to the access roads and individual well sites with areas between the well sites would remain undisturbed. However, desert tortoises would be excluded from use of the entire site during operation of the mine.

The proposed gypsum deposition area was described in the biological assessment as supporting a low density of desert tortoises. However, this density estimate is based on a survey of a 92 acre site, which is larger than the area that was actually proposed. Also, as discussed previously in this biological opinion, this density estimate was determined during an extended drought when desert tortoise abundance was occasionally underestimated during surveys. Bureau staff estimate, with supporting evidence from surveys conducted in an adjacent area, that the proposed location for the gypsum deposition area contains more desert tortoises than is indicated by the biological assessment. The area immediately west of the existing processing plant (i.e., the NW¼SW¼ of section 25) supports fewer desert tortoises than the proposed site (T. Egan, Barstow Resource Area, Bureau, personal communication) and may be a viable site for the gypsum holding area.

The proposed action may also have several indirect adverse impacts on the desert tortoise. Construction activities, facility operation, and carcasses of animals killed on the access roads could result in the attraction of common ravens, which are known to prey on desert tortoises, to the vicinity of the Fort Cady facility. The access routes, both within and to the project area, would fragment desert tortoise habitat through the establishment of barriers to movement. Non-project associated use of the access roads would also potentially add to the number of road-killed animals and increase opportunities for vandalism and collection of desert tortoises.

The description of the proposed action does not specify how storm water would be diverted around the gypsum deposition area by the interceptor ditch. The diversion of sheet flow or washes across the bajada has the potential to alter the plant communities and physical structure of the habitat downslope from the ditch. These impacts have not been quantified and may not be possible to mitigate.

Fragmentation of desert tortoise populations may occur where above ground water and solution pipelines would restrict the movement of animals. The recommended mitigation measures in the biological assessment are to bury or place fill dirt over the pipeline every 1/2 mile to allow passage of desert tortoises. We anticipate that desert tortoise-proof fencing along the main access road from the freeway and around the solution well field and other major project facilities, with the subsequent removal of desert tortoises from these areas, would eliminate the need to provide passage for animals over pipelines in these areas. However, the above ground water well line is over six miles long, which may render the installation of desert tortoise-proof fencing infeasible. The recommended passages at 1/2-mile intervals may not be adequate to allow adult desert tortoises to cross the pipeline while remaining within their home ranges. Also, hatchling desert tortoises, which have presumably much smaller activity areas, could be even more restricted in their movements.

Desert tortoises would also be at risk from maintenance of project facilities that lie outside of areas protected by desert tortoise-proof fences, such as along the water well pipeline. The recommended speed limit of 25 miles per hour in the biological assessment would not allow drivers to see smaller desert tortoises in time to avoid them.

The Bureau's request for formal consultation also notes that the applicant would be required to compensate, through the acquisition of private lands their subsequent transferral to the Bureau, for habitat that would be destroyed by the proposed action. Such acquisitions have the potential to improve the overall management of the species, as desert tortoise habitat is brought into public ownership and becomes subject to Federal regulation of multiple use. Acquired lands also are eligible for inclusion in habitat enhancement and management plans which could further improve their wildlife values. Therefore, implementation of the proposed action would include the acquisition and management of compensation lands which support desert tortoises, and would result in some beneficial impact to this species.

The Service believes that the impacts described above will not jeopardize the continued existence of the species. We present this conclusion for the following reasons:

1. Although the proposed project area consists of 7,000 acres, a relatively small portion would be disturbed by project activities. The proposed facilities would be located in several discrete areas that would disperse the impacts to the desert tortoise.

2. The Bureau's biological assessment includes mitigation measures which would reduce the take of individual desert tortoises and their habitat, and should not fragment desert tortoise populations within the area.

Cumulative Effects

Cumulative effects are those impacts of future State and private actions that are reasonably certain to occur in the project area. Future Federal actions will be subject to the consultation requirements established in section 7 of the Act and, therefore, are not considered cumulative to the proposed project.

Many of the actions that are reasonably expected to occur within the vicinity of the project will be subject to section 7 consultations, because large portions of the desert consist of Federal lands. Numerous unauthorized actions on both Federal and non-Federal lands, such as collection and vandalism of desert tortoises and off-highway vehicle use, will continue to degrade desert tortoise populations and their habitat, particularly in areas that receive large amounts of recreational use. The general vicinity of the project area is not known to receive intensive use for recreation.

The Service has contacted the Counties of Inyo, San Bernardino, Kern, Riverside, and Los Angeles (and the incorporated areas within the desert) regarding the listing of the desert tortoise and its implications for activities permitted by these agencies. Several agencies in these counties have expressed interest in attempting to obtain a section 10(a)(1)(B) permit from the Service in connection with a coordinated Habitat Management Plan/Habitat Conservation Plan. This plan, which is currently being developed by the Bureau, Service, California Department of Fish and Game, local agencies, and numerous interest groups in the desert, would be submitted in support of a section 10(a)(1)(B) permit application.

Incidental Take

Section 9 of the Act prohibits the take of listed species without special exemption. Taking is defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, collecting, or attempting to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. Under the terms of sections 7(b)(4) and 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this incidental take statement. The measures described as reasonable and prudent measures and terms and conditions in this biological opinion are nondiscretionary, and must be undertaken by the agency or made a binding condition of any grant or permit, as appropriate.

This biological opinion anticipates the following forms of take which would be associated with implementation of the reasonable and prudent measures:

1. Three (3) desert tortoises in the form of direct mortality during construction of project facilities.

2. One (1) desert tortoise every two (2) years in the form of direct mortality during operation of the proposed facility.

3. Thirty (30) desert tortoises in the form of harassment resulting from moving animals out of harm's way during construction and operation of the proposed project.

This biological opinion does not authorize any form of take that is not incidental to construction and operation of the mining operation proposed by the Fort Cady Minerals Corporation.

If the incidental take authorized by this biological opinion is met, the Bureau shall immediately notify the Service in writing. If the incidental take authorized by this biological opinion is exceeded, the Bureau shall immediately notify the Fort Cady Minerals Corporation to cease the activity resulting in the take and shall reinitiate formal consultation with the Service.

Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures are necessary and appropriate to minimize the incidental taking authorized by this biological opinion:

1. Worker education programs, defined work areas, and well-defined operational procedures shall be implemented, with the cooperation of on-site qualified biologists, to avoid the take of desert tortoises and minimize loss of their habitat during construction and operation of the proposed mining operation.

2. Attraction of common ravens and other potential tortoise predators to the project area areas shall be reduced to the maximum extent possible.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Bureau is responsible for compliance with the following terms and conditions, which implement the reasonable and prudent measures described above.

1. If the Fort Cady Minerals Corporation fails to comply with any of the reasonable and prudent measures or terms and conditions of this biological opinion, the Bureau shall suspend the right-of-way permit for the public lands until such time that the Fort Cady Minerals Corporation is in compliance with these terms and conditions. The Bureau shall also notify the Fort Cady Minerals Corporation at that time that failure to comply will lead to revocation of the right-of-way permit.

2. The Bureau shall ensure that the following mitigation measures, submitted by the Bureau with the request for formal consultation and slightly modified herein by the Service, are implemented:

    2.1 The mine operator shall designate a field contact representative (FCR) who will be responsible for overseeing compliance with protective stipulations for the desert tortoise and for coordination on compliance with the Bureau and the Service. The FCR shall have the authority to halt all mining activities that are in violation of the stipulations. The FCR may be the mine operator, the mine manager, any other mine employee, or a contracted biologist.

2.2 An employee education program must be received, reviewed, and approved by the Bureau at least 15 days prior to the presentation of the program. The program may consist of a class or video presented by a qualified biologist (Bureau or contracted) or a video. Wallet-sized cards with important information for workers to carry are recommended. All mine employees and contractors shall participate in the desert tortoise education program prior to initiation of mining activities. The operator shall be responsible for ensuring that the education program is developed and presented prior to conducting activities. New employees shall receive formal, approved training prior to working on-site. The program shall cover the following topics at a minimum:

- distribution of the desert tortoise,
- general behavior and ecology of the desert tortoise,
- sensitivity to human activities,
- legal protection,
- penalties for violations of State or Federal laws,
- reporting requirements, and
- project protective mitigation measures.

2.3 Only biologists authorized by the Service and the Bureau shall handle desert tortoises. The mine operator shall submit the name(s) of the proposed authorized biologist(s) to the Service for review and approval at least 15 days prior to the onset of activities. No mining activities shall begin until an authorized biologist is approved.

2.4 The authorized biologist shall be required on-site during pre-construction and construction activities which could harm desert tortoises. This biologist shall have authority from the operator to halt any action that might result in harm to a desert tortoise.

2.5 The area of disturbance shall be confined to the smallest practical area, considering topography, placement of facilities, location of burrows, pubic health and safety, and other limiting factors. Work area boundaries shall be delimited with flagging or other marking to minimize surface disturbance associated with vehicle straying. Special habitat features, such as burrows, identified by the qualified biologist shall be avoided to the extent possible. To the extent possible, previously disturbed areas within the mining site shall be utilized for the stockpiling of excavated materials, storage of equipment, digging of slurry and borrow pits, location of office trailers, and parking of vehicles. The qualified biologist, in consultation with the project proponent, shall ensure compliance with this measure.

2.6 All project facilities, including any borrow pits, shall be enclosed within desert tortoise-proof fences. The fences shall be constructed under the direction of the authorized biologist or a Bureau compliance technician. The fences shall be located to avoid all desert tortoise burrows; to the extent possible, burrows will be placed on the outside of the exclosures. The fences shall be constructed of 1/2-inch mesh hardware cloth. They shall extend 18 inches above ground and 12 inches below ground. Where burial of the fences is not possible, the lower 12 inches shall be folded outward against the ground and fastened to the ground so as to prevent entry by desert tortoises. The fences shall be supported sufficiently to maintain their integrity. The fences shall be checked at least monthly and maintained when necessary by the mine operator to ensure their integrity. All desert tortoise-proof fencing shall be removed after site rehabilitation.

2.7 After fence installation, the authorized biologist shall conduct a thorough survey for desert tortoises within all enclosed areas. All desert tortoises found shall be marked and removed from the exclosures and placed outside the nearest fence. If the removal is during the season of above-ground activity, the desert tortoises shall be placed beside a nearby burrow of appropriate size. If the removal is not in the season of above-ground activity, the desert tortoise shall be moved (dug out of burrow if necessary) on a seasonably warm day and placed at the mouth of a nearby burrow of appropriate size. If the desert tortoise does not enter the burrow, an artificial burrow may be needed. The authorized biologist shall be allowed some judgement and discretion to ensure that survival of the desert tortoise is likely.

2.8 Desert tortoises moved from within a fenced site shall be marked for future identification. An identification number using the acrylic paint/epoxy covering technique shall be placed on the fourth left costal scute (Fish and Wildlife Service 1991). 35-mm slide photographs of the carapace, plastron, and the fourth costal scute shall be taken. No notching is authorized.

2.9 Desert tortoises may be handled only by the authorized biologist and only when necessary. New latex gloves shall be used when handling each desert tortoise to avoid the transfer of infectious diseases between animals. In general, desert tortoises should be moved the minimum distance possible to ensure their safety. The authorized biologist(s) shall follow the general handling methods contained in the "Protocols for Handling Live Tortoises" (Arizona Game and Fish Department et al. 1991). This biological opinion does not authorize replacement of lost fluids in any desert tortoise with a syringe or the drawing of blood.

2.10 The authorized biologist shall maintain a record of all desert tortoises encountered during mining activities. This information shall include for each desert tortoise:

1) the locations (narrative and maps) and dates of observations;
2) general condition and health, including injuries and state of healing and whether animals voided their bladders;
3) location moved from and location moved to; and
4) diagnostic markings (i.e., identification numbers or marked lateral scutes).

2.11 No later than 90 days after completion of construction activities, the FCR and authorized biologist shall prepare a report for the Bureau. The report shall document the effectiveness and practicality of the mitigation measures, the number of desert tortoises excavated from burrows, the number of desert tortoises moved from the site, the number of desert tortoises killed or injured, and the specific information for each desert tortoise as described in measure 10. The report shall make recommendations for modifying the stipulations to enhance desert tortoise protection or to make it more workable for the operator. The report shall provide an estimate of the actual acreage disturbed by various aspects of the operation.

2.12 All trash and food items shall be promptly contained within raven-proof containers. These shall be regularly removed from the project site to reduce the attractiveness of the area to common ravens and other desert tortoise predators.

2.13 Structures that may function as common raven nesting or perching sites are not authorized except as specifically stated by the Bureau. The project proponent shall describe anticipated structures to the Bureau during initial project review.

2.14 At the end of the project, disturbed areas, including new access roads, shall be recontoured and reseeded with an appropriate mixture of native plant species according to Bureau specifications. After site rehabilitation, all desert tortoise-proof fence shall be removed.

2.15 The project proponent shall acquire and transfer to the Bureau 1,480 acres of off-site desert tortoise habitat lands to compensate for the unmitigated impacts of the project on the desert tortoise. All compensation lands shall be within Bureau-designated Category I tortoise habitat within the West Mojave Region and shall be approved by the Bureau prior to satisfaction of this requirement. Acquisition of compensation lands shall be coordinated through the Bureau's California Desert District Realty Staff. Compensation requirements must be satisfied within one year of mining plan authorization.

3. The Bureau shall ensure that common ravens do not nest on any structures erected by the Fort Cady Minerals Corporation. Any above-ground utility poles shall be designed and installed to preclude nesting by common ravens. If common ravens construct nests on its facilities, the Fort Cady Minerals Corporation or the Bureau shall be responsible for obtaining the appropriate permit from the Service's Division of Law Enforcement to remove the nests. The Bureau shall also ensure that the Fort Cady Minerals Corporation monitors common raven use in the vicinity of the proposed facility in accordance with standard Bureau raven monitoring techniques.

4. Fragmentation of desert tortoise habitat shall be reduced through the installation of culverts or underpasses under the access roads and the railroad at all washes and at 0.5 mile intervals. Culvert size, location, and installation shall be in accordance with methods developed by the Bureau's Desert Tortoise Research Group. Culverts or underpasses shall be maintained

to remove trash and other debris at least twice per year and to ensure that they are in all ways passable to desert tortoises, prior to its spring and late summer activity periods.

5. If desert tortoise-proof fencing is not constructed along the water pipeline, all project-associated vehicles shall maintain a speed limit of 20 miles per hour on this access road. The water pipeline shall be either buried or elevated for at least 100 feet every 1/4 to 1/2 mile to allow for the passage of desert tortoises. If the pipeline is elevated, the Bureau shall ensure that the height of elevation will allow for the free passage of the largest possible desert tortoise.

6. The Bureau shall require the Fort Cady Minerals Corporation to relocate the gypsum deposition area to an area containing a relatively low density of desert tortoises. We suggest that the area immediately west of the existing processing plant (i.e., the NW¼SW¼ of section 25) be evaluated as a potential alternate site for the deposition area.

7. A speed limit of 20 miles per hour shall be maintained by all employees and contractors of the Fort Cady Minerals Corporation on all project roads that are not protected by desert tortoise-proof fencing.

8. When outside of areas enclosed by desert tortoise-proof fences, workers shall inspect underneath any parked vehicles immediately prior to moving the vehicles. If a desert tortoise is beneath the vehicle, the authorized biologist shall be contacted to move the desert tortoise from harm's way. Alternatively, the vehicle shall not be moved until the desert tortoise has left of its own accord. The authorized biologist shall be responsible for taking appropriate measures to ensure that any desert tortoise moved in this manner are not exposed to temperature extremes which could be harmful to the animal.

9. When maintenance activities occur outside of areas enclosed by desert tortoise-proof fences, work areas shall be surveyed by the authorized biologist prior to the onset of maintenance to determine whether desert tortoises are present. If desert tortoises are present, the appropriate terms and conditions of this biological opinion shall be implemented to avoid take. All trenches, holes, or other hazards to desert tortoises shall be surrounded by desert tortoise-proof fencing or eliminated as hazards prior to the workers leaving the site. Alternatively, if fence construction is not feasible, the authorized biologist shall be present at all times that hazards to desert tortoises exist.

10. The authorized biologist shall instruct appropriate mine employees, such as environmental compliance personnel or project managers, in the proper method of handling desert tortoises in the event of emergencies involving animals during routine operation of the facility. Alternatively, the Fort Cady Minerals Corporation shall retain a local biologist, to be authorized by the Service and the Bureau, who would be available on short notice in the event of an emergency. All desert tortoises handled under emergency circumstances shall be reported to the Service and Bureau immediately and the

information described in term and condition 2.10 of this biological opinion shall be collected.

Disposition of Dead, Injured, or Sick Desert Tortoises

Upon locating dead, injured, or sick desert tortoises, initial notification must be made within three working days of the finding to the Service's Division of Law Enforcement in Torrance, California, at (310) 297-0062. The Service's Ventura Office should also be notified at (805) 644-1766. Written notification to both offices must be made within five calendar days and include the date, time, and location of the carcass, a photograph, and any other pertinent information. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state. The Bureau shall endeavor to place the remains of intact desert tortoises with educational or research institutions holding the appropriate State and Federal permits per their instructions. If such institutions are not available or the shell has been damaged, the information noted above shall be obtained and the carcass left in place. The Bureau should consider marking the carcass in a manner that would not be toxic to other wildlife to ensure that it would not be re-recorded in the future.

Arrangements regarding proper disposition of potential museum specimens shall be made with the institution by the Bureau prior to implementation of the action. Injured animals should be transported to a qualified veterinarian. Should any treated desert tortoises survive, the Service should be contacted regarding the final disposition of the animals.

Conservation Recommendations

In furtherance of the purposes of the Endangered Species Act (sections 2(c) and 7(a)(1)) that mandate Federal agencies to utilize their authorities to carry out programs for the conservation of listed species, we recommend implementing the following actions:

1. The Bureau should assist the Fort Cady Minerals Corporation in evaluating alternative means of providing flood protection to the facility that would not adversely affect desert tortoise habitat downslope from the diversion structure. The Service is concerned that alteration of flood flows by the proposed structure would result in unquantifiable deterioration of desert tortoise habitat.

2. The Bureau should require the Fort Cady Minerals Corporation to closely monitor desert tortoises that are translocated during project construction through use of radio transmitters to ensure the survival of these animals. Such a program would also provide valuable information on the effectiveness of this commonly used mitigation measure in reducing take. The Service's Ventura Office is willing to assist the Bureau and the Fort Cady Minerals Corporation with receiving authorization for this monitoring, either under the auspices of this biological opinion or through a section 10(a)(1)(A) permit.

3. The Bureau should prepare and implement a management plan for desert tortoises and other sensitive biological resources in the vicinity of the Pisgah lava flows. This area supports desert tortoises in extremely unusual habitat conditions for the western Mojave Desert, but has been largely overlooked in recent planning efforts.

The Service requests notification of the implementation of any conservation recommendations so we can be kept informed of actions that either minimize or avoid adverse effects, or that benefit listed species or their habitats.

Conclusion

This concludes formal consultation on the Fort Cady Project Mining Plan Proposal. Reinitiation of formal consultation is required if: 1) the amount or extent of incidental take is reached; 2) new information reveals effects of the agency action that may adversely affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; 3) the agency action is subsequently modified in a manner that causes an effect to a listed species or critical habitat that was not considered in this biological opinion; or 4) a new species is listed or critical habitat designated that may be affected by this action (50 CFR 402.16). We would appreciate notification of your final decision on this matter. Any questions or comments should be directed to Ray Bransfield at the Ventura Office at (805) 644-1766.

Attachment: Figure 1 from Dames and Moore 1992.

Literature Cited

Arizona Game and Fish Department, California State Resource Agencies, Nevada Department of Wildlife, Utah Division of Wildlife Resources, United States Department of the Interior, Bureau of Land Management, Fish and Wildlife Service. 1990. Protocols for handling live tortoises. In: Interim techniques handbook for collecting and analyzing data on desert tortoise populations and habitats. In: procedures for Endangered Species Act compliance for the Mojave desert tortoise. United States Department of the Interior, Fish and Wildlife Service. 1990. Regions 1, 2, and 6.

Arizona Game and Fish Department, California State Resource Agencies, Nevada Department of Wildlife, Utah Division of Wildlife Resources, United States Department of the Interior, Bureau of Land Management, Fish and Wildlife Service. 1991. Protocols for handling live tortoises. In: Interim techniques handbook for collecting and analyzing data on desert tortoise populations and habitats. In: procedures for Endangered Species Act compliance for the Mojave desert tortoise. United States Department of the Interior, Fish and Wildlife Service. 1991. Regions 1, 2, and 6.

Burge, B.L. 1978. Physical characteristics and patterns of utilization of cover sites by Gopherus agassizii in southern Nevada. Proc. 1978 Symp., The Desert Tortoise Council. pp. 80-111.

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Dames and Moore. 1992. Biological assessment. Fort Cady Minerals Corporation. Job #21864-001-001. Las Vegas, Nevada.

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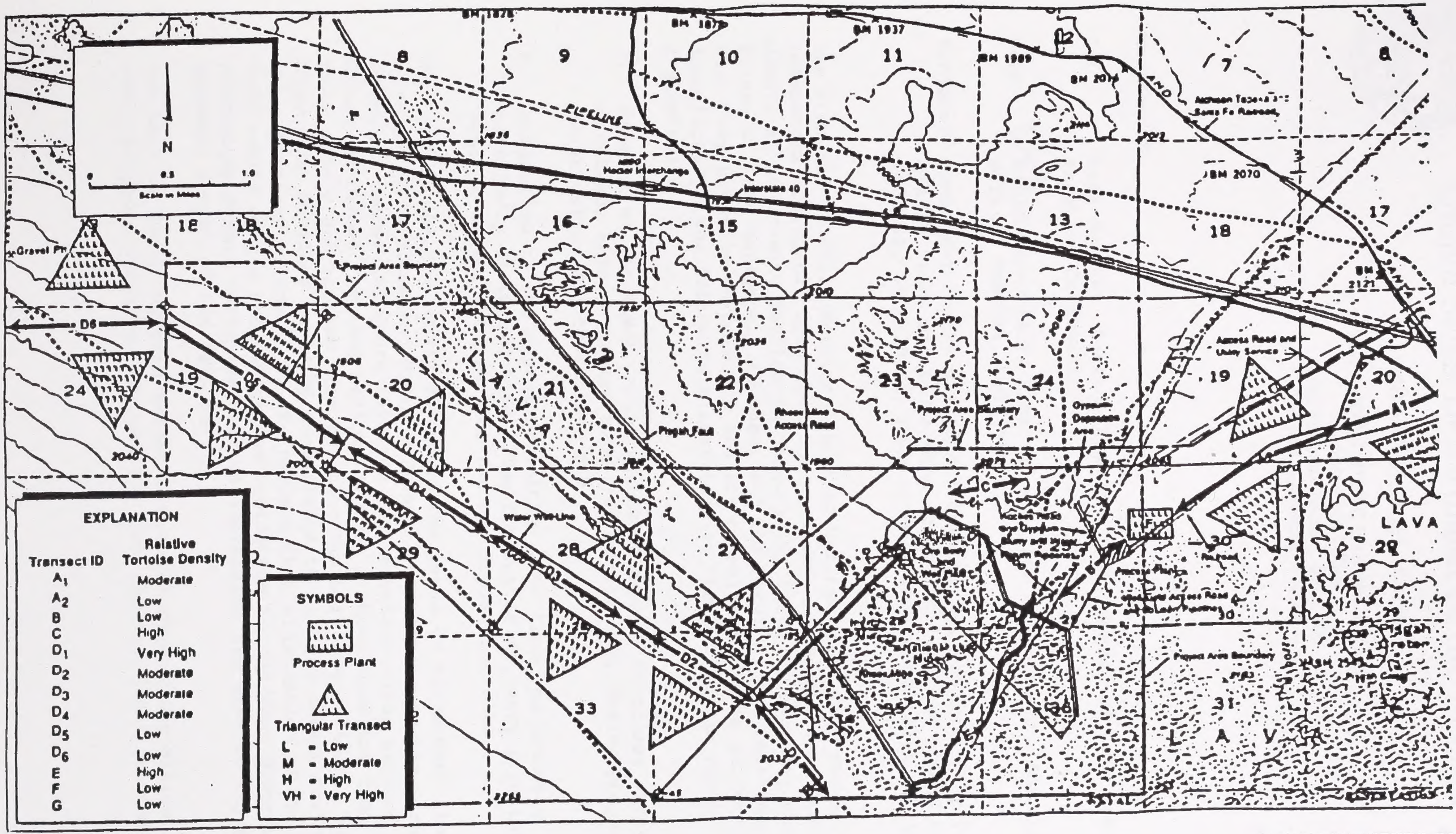
Weinstein, M., K.H. Berry, and F.B. Turner. 1987. An analysis of habitat relationships of the desert tortoise in California. A report to Southern California Edison Company.



EXPLANATION

Transect ID	Relative Tortoise Density
A_1	Moderate
A_2	Low
B	Low
C	High
D_1	Very High
D_2	Moderate
D_3	Moderate
D_4	Moderate
D_5	Low
D_6	Low
E	High
F	Low
G	Low

SYMBOLS

▨ Process Plant

△ Triangular Transect

L = Low
M = Moderate
H = High
VH = Very High

AREAS SURVEYED F
DESERT TORTOIS
Fort Cady EIR
Fort Cady Minerals Corpora
Newberry Springs,
FEBRUARY 1

DAMES & MOORE
21864-001-001.ASFDT

FIGURE 1

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE

FISH AND WILDLIFE ENHANCEMENT
Ventura Field Office
2140 Eastman Avenue, Suite 100
Ventura, California 93003

[illegible] 13 AM 1:43

April 9, 1993

Memorandum

To: Area Manager, Barstow Resource Area, Bureau of Land Management, Barstow, California

From: Field Supervisor, Fish and Wildlife Enhancement, Ventura Field Office, Ventura, California

Subject: Amendment to the Biological Opinion for the Fort Cady Project Mining Plan, San Bernardino County, California (CAMC 20175, CACA 2853-32, CACA 28182, CACA 31199, 3809(CA-068.32)) (1-6-92-F-54)

The Fish and Wildlife Service (Service) has reviewed your request to amend the referenced biological opinion. The proposed amendments were discussed in detail at an on-site meeting on January 28, 1993, attended by staff from the Bureau of Land Management (Bureau) and the Service, and representatives of the Fort Cady Minerals Corporation and its consultant, Dames and Moore. Specifically, the following alterations to the biological opinion have been requested:

1. Removal of the limit on the number of desert tortoises which could be harassed, through moving them from harm's way, during project construction and operation; and

2. Relocation of the gypsum deposition area from the proposed location to a previously disturbed site. The freshwater delivery pipeline would also need to be moved to service the new deposition site.

The Service has previously discussed the issue of harassment limits for desert tortoises with Dames and Moore personnel in relation to the Kern river Pipeline. Dames and Moore observed that monitors often watched individual desert tortoises for long periods of time without handling them to ensure their safety and to keep from reaching the harassment limit. During these times, the monitors would be unavailable to protect desert tortoises along other portions of the line. We believe that elimination of the harassment limit would enable the authorized biologists to use more discretion in protecting desert tortoises without increasing the adverse impacts of the proposed action on the species.

The Service fully supports relocation of the gypsum deposition area to the newly proposed location. We believe that the new location would greatly reduce the direct and indirect impacts of the proposed action on the desert tortoise, and fully meets the intent of term and condition 6. Therefore, amendment of the biological opinion for the relocation of the deposition area is not required. The impacts of the water delivery pipeline and the measures proposed to mitigate the impacts would remain the same under the alternative site and are thus covered by the biological opinion.

We understand that the revised compensation acreage is in conformance with the policies of the Desert Tortoise Management Oversight Group.

The referenced biological opinion is hereby amended in the following manner:

1. The incidental take limit of 30 desert tortoises in the form of harassment from moving animals from harm's way during construction and operation of the proposed project is deleted from the biological opinion.

2. The first sentence of term and condition 2.15 now reads: The project proponent shall acquire and transfer to the Bureau 341 acres of off-site habitat desert tortoise habitat lands to compensate for the unmitigated impacts of the project on the desert tortoise.

Staff at the Ventura Field Office are available to assist the Bureau in obtaining appropriate authorization for monitoring desert tortoises that may be moved as a result of the proposed action. Please notify us as study plans are developed so we can assist you as efficiently as possible.

The Service would like to extend its full appreciation to the Bureau for its efforts to conserve the desert tortoise and other biological resources in the Fort Cady area, and we look forward to continued cooperation with you and your staff. If you have any questions concerning these comments, please contact Ray Bransfield of my staff at (805) 644-1766.

Judy Hohman

cc: BLM, Sacramento, CA
BLM, Riverside, CA

APPENDIX D:

CULTURAL RESOURCES REPORT (ON FILE WITH LEAD AGENCIES)

APPENDIX E:

BIOLOGICAL RESOURCES REPORT
(ON FILE WITH LEAD AGENCIES)

APPENDIX F:

MINING AND LAND RECLAMATION PLAN (APPENDICES ON FILE WITH LEAD AGENCIES)

REVISED MINING
AND
LAND RECLAMATION PLAN

FORT CADY PROJECT
NEWBERRY SPRINGS, CALIFORNIA

FORT CADY MINERALS CORPORATION

MAY 1993

REVISED MINING PLAN

FORT CADY PROJECT
NEWBERRY SPRINGS, CALIFORNIA

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MINING PLAN

1. MINING OPERATION INTRODUCTION

1.1 BACKGROUND INFORMATION

1.1.1 Summary

This revised Mining and Land Reclamation Plan (Plan) has been prepared to describe the components of the Mine Plan and the procedures to be implemented to reclaim the disturbed areas associated with the proposed Fort Cady Minerals Corporation (FCMC) Solution Mining Project. This plan has been prepared in accordance with Federal, State and County requirements. The plan was compiled using the U.S. Department of the Interior Bureau of Land Management (BLM) Manual Handbook H-3042-1 "Solid Minerals Reclamation Handbook" (April 8, 1992), the California Department of Conservation, Division of Mines and Geology "Surface Mining and Reclamation Act of 1975 Public Resources Code 2710-2795", "Article 9, Reclamation Standards 3700-3713" (January 15, 1993), the "Reclamation Bond Calculation/Evaluation Guide (September, 1989), and the Financial Assurance Guidelines" (August 13, 1992), and the San Bernardino County "Mining and Land Reclamation Plan Application Forms and Information" (July, 1, 1991).

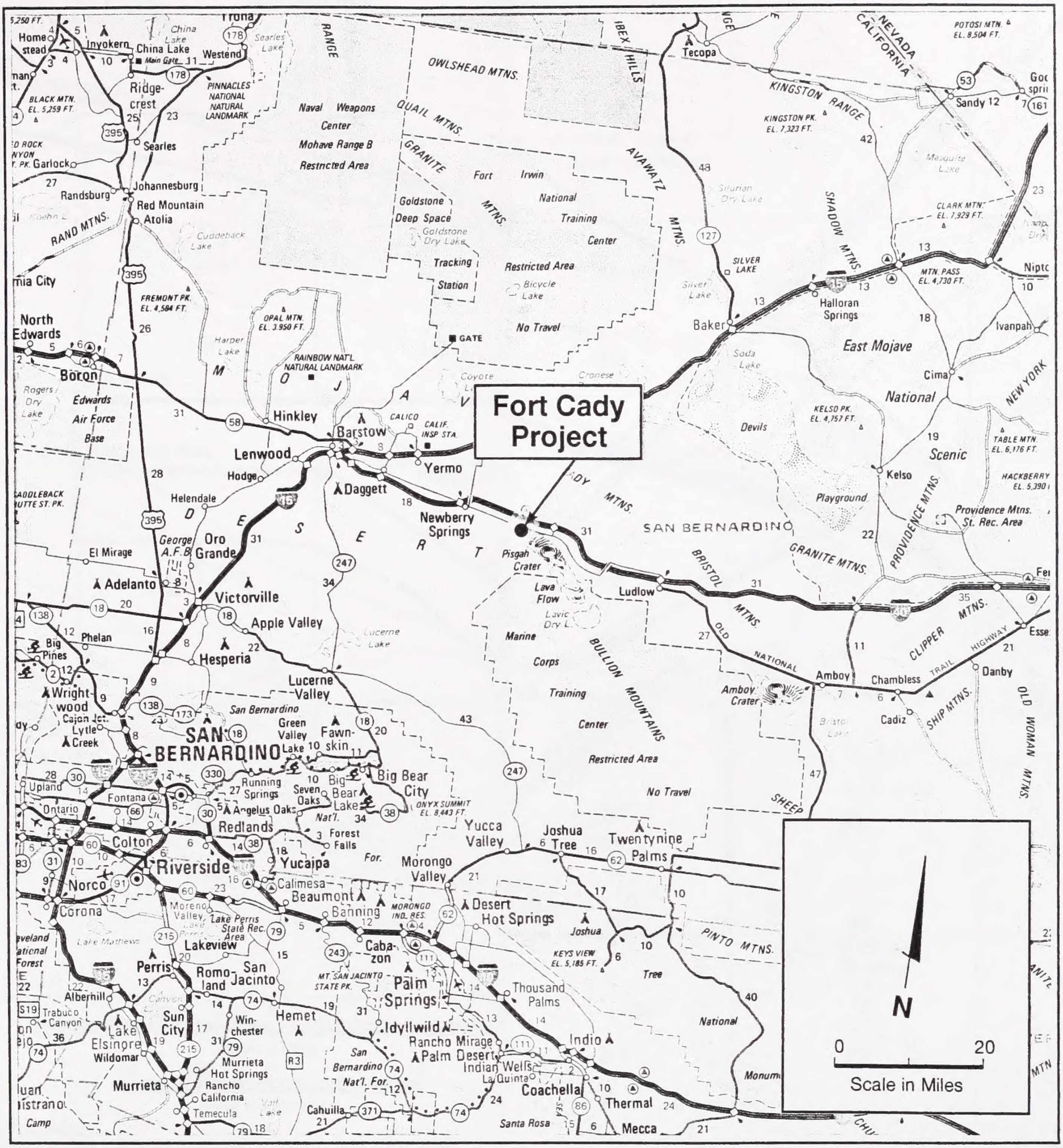
Many sections in the revised plan are included as direct quotations from the FCMC Solution Mining Project Administrative Draft Environmental Impact Statement/Environmental Impact Report (Draft EIS/EIR) prepared for FCMC by Dames & Moore in March 1993.

The site of the proposed FCMC Solution Mining Project is located in San Bernardino County near Pisgah Crater, approximately 40 miles east of Barstow and 17 miles east of Newberry Springs, California. The site is about two and one-half miles south of Interstate 40 (I-40) and the Atchison Topeka and Santa Fe Railway Pisgah siding in the Mohave Desert (Figure 1-1). The project area consists of approximately 6,500 acres, of which 342.5 acres would be disturbed (Figure 1-2).

"FCMC is proposing to construct and operate a borate production mine and processing facility with the capacity of producing 90,000 tons of borate product per year. This project would include a 273-acre ore body well field, a 10-acre processing facility, a 16-acre gypsum deposition area, and 43.5 acres of ancillary services, a process water supply well network, a railway spur, a natural gas pipeline, access roads, and electric lines and facilities." The project would involve the in-situ mining process, which would involve injecting a weak acid solution into the borate ore body to extract the borate product. The mineral would be processed in an on-site plant, and the final borate product, and the by-product, gypsum, would be sold to various markets."

The original Mining and Reclamation Plan (Original Plan) was submitted to the County of Bernardino (County) in April 1990. The proposed action at that time involved utilizing a solar evaporation method of concentrating the borate product. However, after evaluating the environmental impacts, along with other considerations, FCMC decided to utilize the solvent extraction method to purify and concentrate the borate product. This revised plan addresses the mining and reclamation procedures associated with these changes to the process.

This section of the plan contains a description of FCMC ownership, history of the project, technology of the mining process, ore reserves, and land holding status for the project area. Section 1.2 of the report describes the project development activities that lead to FCMC's decision to proceed with the commercial operations. Section 1.3 provides a description of the in-situ solution

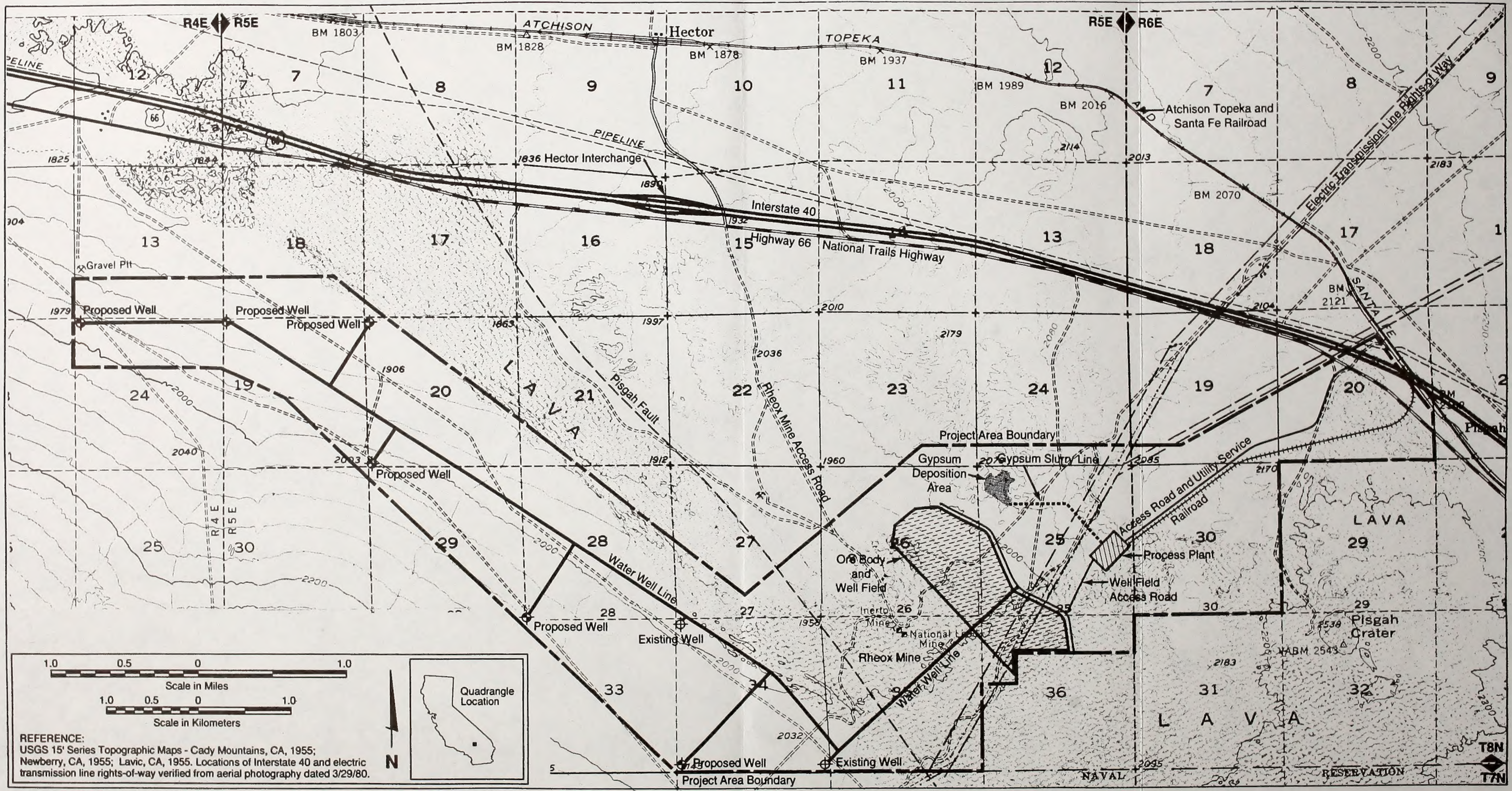


REFERENCE: AAA California Road Map, 1991

VICINITY OF THE PROPOSED PROJECT

Fort Cady Mining and Land Reclamation Plan
Fort Cady Minerals Corporation
MARCH 1993

FIGURE 1-1



REFERENCE: Administrative Draft Environmental Impact
Statement / Environmental Impact Report
Fort Cady Minerals Corporation
Solution Mining Project
Prepared by Dames & Moore, March 1993

PROJECT AREA
Fort Cady Mining and Land Reclamation Plan
Fort Cady Minerals Corporation
MARCH 1993

FIGURE 1-2

mining operations. Sections 2 through 5 provide further information on the proposed project, including a discussion of mine wastes, the ore processing method, water data, and erosion and sedimentation control. No explosive devices will be used in this mining project, therefore this plan does not address blasting issues. This plan will not address blasting. The text in the Appendices provides further details of the in-situ mining and processing stages.

1.1.2 Brief Description of the Project

Ownership

FCMC was incorporated in March 1989 under the laws of the province of Ontario, Canada, and is 80 percent owned by Dundee Bancorp, Inc., and 20 percent owned by Mountain States Mineral Enterprises (MSME), Inc., an unrelated corporation, to conduct the development and exploitation of the Fort Cady Project.

Dundee Bancorp, Inc., an Ontario corporation, is publicly traded on the Toronto Stock Exchange and the Montreal Exchange. Fort Cady (California) Corporation, a wholly-owned subsidiary of Fort Cady Minerals Corporation, holds certain portions of the Fort Cady real property.

History

"Exploration and mining of hectorite clay in the project area has continued without interruption since the early 1930s. Rhoex, Inc. currently operates a large open-pit mine to recover high-grade hectorite clay approximately one-half mile southwest of the proposed Fort Cady ore body and well field. Less than two miles to the southeast of the project area, Kiewit Mining Group, Inc. (Pisgah Mining Operations, also called the Twin Mountain Mine) once mined a basaltic lava aggregate within Pisgah Crater; however, this mine is currently inactive."

"The project region is known to contain several borate-bearing deposits, most notably deposits at Calico Mountain, deposits around Boron, California, and deposits found farther north, especially in and around Searles Lake, California."

"Initial discovery of the FCMC borate deposit occurred in 1964 when the Congdon Exploration Company found several zones of colemanite, a calcium borate mineral, between the depths of 1,330 and 1,570 feet below the surface in Section 26, T8N, R5E. In September 1977, Duval Corporation initiated land acquisition and exploration activities near Hector, California, and by March 1981 had completed 33 exploration holes in an approximately 800-foot drilling grid configuration on the project site. As a result of that drilling program, it was estimated that a borate ore body of sufficient size and grade existed to warrant further investigation."

"In 1981, Duval Corporation began conventional underground mine planning. Because of the depth of the ore body, it appeared that underground mining methods would not be technically or economically feasible for use in its recovery. However, subsequent studies and tests indicated that in-situ technology could be a feasible method to employ in mining the FCMC colemanite ore body, and a pilot mining and processing operation was initiated in order to explore this possibility."

1.1.3 Technology

Solution Mining

In-situ leaching technology was developed commercially in the 1970s and involves the injection of a leachate through a permeable formation in the ground for selective dissolution of the ore mineral of interest in the ore body. The solution is subsequently recovered to surface for processing to produce a saleable product. The technology has been applied to the commercial production of uranium, copper, salt, potash and soda ash and other lesser known commodities.

The technology has several technical, economic, and environmental advantages over other mining practices:

1. Lower capital costs (no earth-moving or ore-handling equipment).
2. Lower fixed and overall operating costs.
3. Flexibility of operation for selective mining (unlike open-pit operation, where all ore and waste must be removed, and underground operations, to a lesser extent).
4. Minimal discharge of solids, liquid, and gaseous effluent.

Duval Corporation found traditional mining methods to be uneconomic for the mining of colemanite, and solution mining was selected as the extraction method when it was determined that the formation was saturated with heavily mineralized groundwater and enveloped in clays.

Duval Process

Duval Corporation patented a recovery process which comprises injection of weak hydrochloric acid solutions into the formation which dissolves the colemanite mineral, forming a solution of borate and calcium chloride. This pregnant solution is recovered to surface and concentrated to the point where crude borate crystals are precipitated. The crude crystals are refined and hydrochloric acid regenerated by reaction of the calcium chloride solution with sulfuric acid. Regeneration using sulfuric acid is less costly than using fresh hydrochloric acid.

The U.S. Patent 4.475.771, dated October 9, 1984, entitled Cyclic Solution Mining of Borate Ores (refer to Appendix B). Foreign patents were awarded in the Federal Republic of Germany, Romania, and the United Kingdom.

Dilute hydrochloric acid, injected into the formation, dissolves the colemanite mineral to form an aqueous solution of boric acid and calcium chloride:

$$\underset{\text{colemanite}}{Ca_2B_6O_{11}.5H_2O} + \underset{\substack{\text{hydrochloric}\\ \text{acid}}}{4HCl} + \underset{\text{water}}{2H_2O} \dashrightarrow \underset{\substack{\text{boric}\\ \text{acid}}}{6H_3BO_3} + \underset{\substack{\text{calcium}\\ \text{chloride}}}{2CaCl_2}$$

This pregnant solution is withdrawn from the formation and a crude boric acid precipitated. The residual liquor, rich in calcium chloride, is then reacted with sulfuric acid to regenerate hydrochloric acid for reinjection and to precipitate gypsum:

$CaCl_2 + H_2SO_4 + 2H_2O = \text{-->} 2HCl + CaSO_4.2H_2O$

calcium sulfuric water hydrochloric gypsum
chloride acid acid

As the colemanite is leached, the formation permeability is increased and new mineral surfaces are exposed to the reactant.

1.1.4 Ore Reserves

Duval developed the following ore reserve data:

Ore Tons	147,435,000
Grade	6.4% B_2O_3
B_2O_3 Tons	9,393,000

At the planned production rate, the reserves are sufficient to maintain operations for approximately 130 years.

1.1.5 Land Holdings Status

A. Leased Lands

The current status of land ownership in the project area is shown on Figure 1-3. The claims leased by FCMC are as follows:

Rheox, Inc. (National Lead Chemicals, Inc.)

Lode Claims

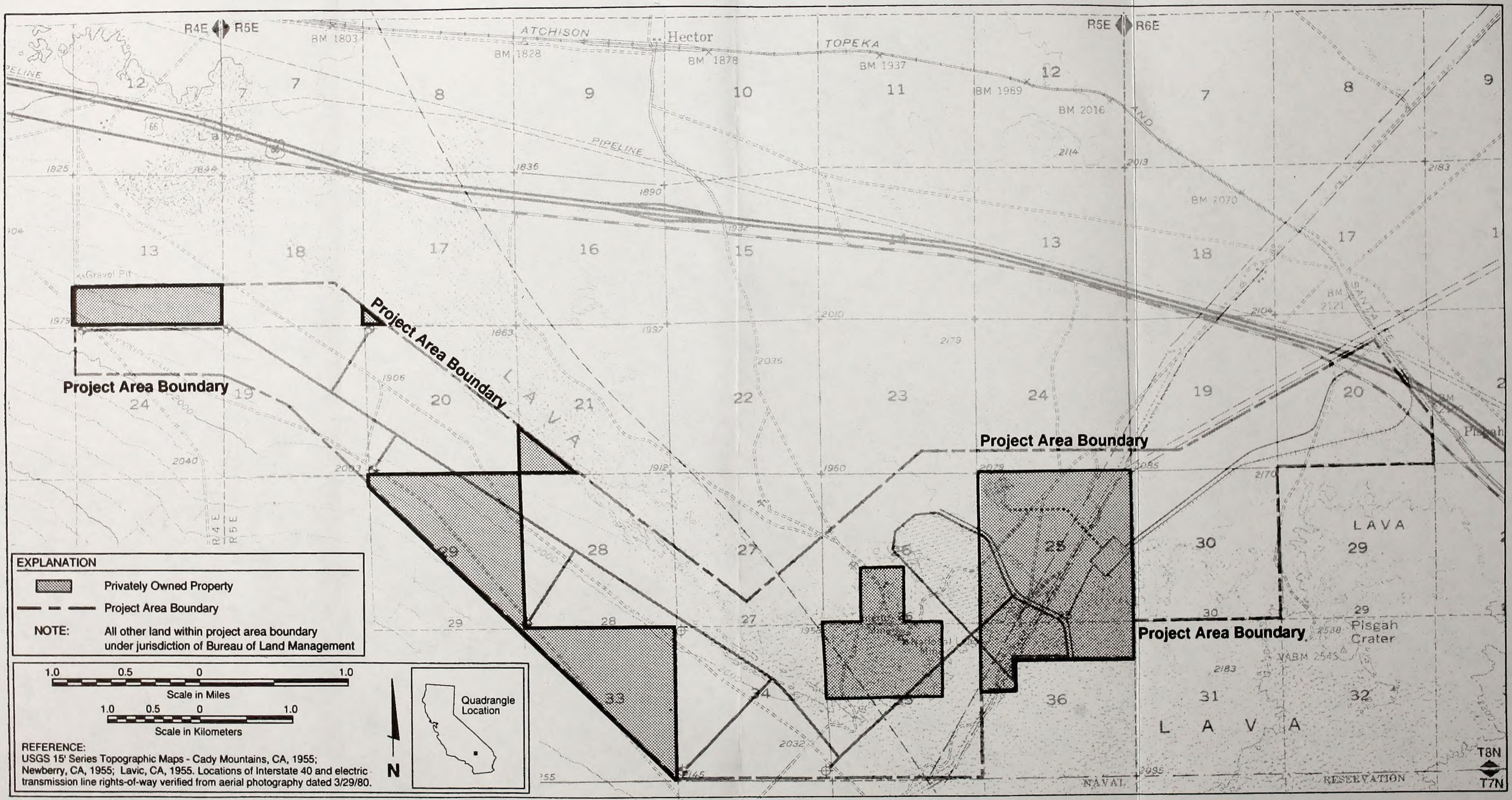
"Some 240 lode mining claims (more or less) are held in portions of Sections 26, 27, 35, and 28, T8N R5E, San Bernardino Base and Meridian (SBBM). Both surface and mineral rights are owned by the BLM but the mineral rights are claimed by Rhoex, Inc., through authority of the Mining Law of 1872, as amended. These claims are leased by FCMC."

Mill Site Claims

"Mill site claims are held in portions of Sections 19, 20, and 28 T8N R5E, San Bernardino Base and Meridian (SBBM) by Rhoex, Inc., and leased to FCMC. Both surface and mineral rights to this property are owned by the BLM."

Southern California Edison Company

"Both surface and mineral rights of the east half and southwest quarter of Section 25 and the north half and northwest quarter and the southwest quarter of the northwest quarter of Section 36, T8N, R5E, SBBM are owned by Southern California Edison Company and are leased by FCMC.



EXPLANATION

▨ Privately Owned Property

— — — Project Area Boundary

NOTE: All other land within project area boundary under jurisdiction of Bureau of Land Management

REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

REFERENCE: Administrative Draft Environmental Impact
Statement / Environmental Impact Report
Fort Cady Minerals Corporation
Solution Mining Project
Prepared by Dames & Moore, March 1993

LAND OWNERSHIP WITHIN THE PROJECT AREA BOUNDARY

Fort Cady Mining and Land Reclamation Plan
Fort Cady Minerals Corporation
MARCH 1993

21864-001-001

FIGURE 1-3

Southern Pacific Land Company

"The northwest quarter of Section 25, T8N, R5E, SBBM. Both surface and mineral rights are owned by the Southern Pacific Land Company and leased to FCMC."

"FCMC's fee land holdings include the northern half of the northeast quarter and the southeast quarter section of Section 36, T8N, R5E, SBBM. A number of unpatented lode mining claims are held by FCMC in parts of Section 34, T8N, R5S; and Section 19 and 30, T8N, R6E.

1.2 PROJECT DEVELOPMENT

1.2.1 Mine Site Approval and Reclamation Plan for Pilot Plant

Development and pilot plant testing has been conducted for over a decade at the Fort Cady project site. An initial Mine Site and Reclamation Plan submitted by Duval for the Pilot Plant was approved by the Office of Planning, San Bernardino County on May 6, 1982, and a Negative Declaration was prepared. On September 23, 1987, the Office of Planning approved a revised Mine site and Reclamation Plan for MSME. In November 1988, MSME requested an extension to the expiration date, since a decision had been made to build a commercial facility which might incorporate the pilot plant. The Office of Planning letter and the revised Mine Site and Reclamation Approval for the Pilot Plant are included in Appendix D.

1.2.2 Waste Discharge Permits

Two Board Orders (Nos. 6-81-103, dated December 10, 1981, and 6-82-71, dated May 13, 1982) were adopted by the California Regional Water Quality Control Board - Lahontan Region. Following submission of data related to Pilot Plant pond operations, a Board Order No. 6-88-63, dated May 12, 1988, was issued. These Board Orders, covering two periods of Pilot Plant operation are included in Appendix D.

FCMC has submitted two documents to the Board related to the waste discharge requirements for the proposed mining and processing facility. FCMC submitted a letter report requesting that waste discharge requirements be waived for the gypsum deposition area (June 22, 1992). FCMC also submitted a Report of Waste Discharge (ROWD) for the mining and processing facility (September 11, 1992). Documentation related to these reports are included in Appendix D.

1.2.3 Air Pollution Control District

The air pollution control permit application requesting authority to construct the mining and processing facility was determined to be complete by the San Bernardino County Air Pollution Control District (APCD) on November 18, 1992. APCD issued authority to construct permits for the project on March 20, 1993 (see Appendix D).

1.2.4 Hazardous Waste and Toxic Control

The Hazardous Waste and Toxic Control Group was first contacted by MSME in August 1987 when information on Pilot Plant operations was provided and a permit application was submitted. A Hazardous Waste Handler Permit was issued to FCMC (see Appendix D).

1.2.5 Office of Building and Safety - Building Permit

MSME filed the application for a building permit for the Pilot-Commercial Plant on July 31, 1987. Prior to construction, FCMC will file an application for a building permit for the process plant.

1.2.6 Pilot Phase I

Duval Corporation began exploration drilling of the Fort Cady property in September 1987, completing 33 cored holes by March 1981. The discovery of a large colemanite deposit, and the concept of the patented cyclic solution mining and process technology prompted them to proceed with preliminary investigations.

"Limited-scale mining on the project site was conducted by MSME starting in July 1986. In these tests, dilute hydrochloric acid solution was injected through a single well into the formation, and boron-rich solution was withdrawn from the same well and discharged into evaporation ponds, where boric acid crystals were precipitated. In this manner, 106,000 pounds of borate product were retrieved. To assess whether or not recrystallization would significantly improve product quality, a test processing plant was constructed. This plant consisted of a crystal slurry feed tank, a horizontal vacuum belt filter, a washed crystal storage bin, and borate product dissolution, decant, and crystallization tanks."

"The Pilot-Commercial Plant (PCP) demonstration was initiated when FCMC became involved in the project. This allowed the company to evaluate, at pilot scale, the workings of the science and technology involved, develop details of design for the commercial facility, predict capital and operating costs, and evaluate environmental aspects of the process and facility. The PCP was in operation from July 1987 to March 1988. As part of the demonstration, its facilities included six production wells, evaporation ponds, and a processing plant. At this plant, 2.25 million gallons of injection solution were injected, and 903,300 pounds of borate product were retrieved."

"At the PCP, four additional solution wells were drilled. The operation system associated with the well field included the following: surface piping, sumps, a new rubber-lined steel storage tank for concentrated hydrochloric acid, and polyethylene storage tanks for mixing and dispensing injection solution. Dilute hydrochloric acid was pumped through fiberglass-reinforced pipes to the test wells during the injection test cycles. Each well was equipped with a recording flowmeter to record the amount of leaching solution injected. An airlift pumping system was used to recover the boron-rich solution: high pressure air was injected to the top of the formation through an airline, which reduced the specific gravity of the solution and caused it to rise to the surface."

"The PCP included three evaporation ponds, the third constructed for surges or emergency storage. The three ponds used in the initial pilot mining operation were converted from storage of solution to storage of process water. The borate product crystallized in the evaporation ponds and was then transferred to the PCP process plant."

"The inactive PCP process plant is housed in a 1,600-square-foot building. In this plant, impurities, such as sand, dirt, and soluble impurities, were removed from the borate product. Several unit operations were evaluated in the plant, including elutriation (purification by washing), filtration, dissolution, crystallization, regeneration, dewatering, and drying. The equipment types evaluated included a vacuum crystallizer, dewatering cyclones, horizontal vacuum belt filter, a centrifuge, and a tray dryer. Service facilities at the PCP included office trailers, acid and reagent storage areas, and an analytical laboratory."

1.2.9 Supplementary Investigations

Several other investigations have been conducted to evaluate material properties and to refine design criteria for thickening, filtration, crystallization, and regeneration components of the processing facility.

1.2.10 Summary

The results of a technical and economic evaluation of a commercial operation to produce 90,000 tons of borate product per year was prepared by MSME in June 1988. The decision was made shortly thereafter to proceed with commercial implementation.

The project has been designed based on the results of conducting two phases of field pilot programs and a Pilot-Commercial Plant operation. The patented process for cyclic solution mining of borate ores had also been tested under a variety of demonstration conditions.

1.3 COMMERCIAL PLANT OPERATIONS

1.3.1 Applied Technology

The Fort Cady project has been the subject of extensive feasibility studies. Over the period, more than $14 million has been expended in defining geological reserves, conducting laboratory and pilot-scale testing, and a Pilot-Commercial Plant to test the processed mining and processing procedures.

In-situ mining of the colemanite deposit was considered to be feasible for the following reasons:

- The ore body is enveloped in impermeable clays.
- The ore formation is saturated with mineralized groundwater.
- The calcite content of the ore is low.
- Minerals, other than colemanite and calcite in the deposit are relatively insoluble.
- Colemanite is the most permeable component in the formation.

The in-situ solution mining technology has advantages in terms of environmental and final reclamation planning:

- Solution mining by the patented cyclic process of regeneration and recycling of hydrochloric acid from calcium chloride does not create waste products. Only borate product and gypsum, which is chemically inert, is produced from the processing pregnant solution from the wells.

- In-situ mining precludes the need for surface disposal of mill tailings of development waste rock.
- The extent of environmental disturbance both physically and visually is much less as compared with the traditional mining methods of open-pit or underground-mining methods.
- Solution mining does not require mine shaft sealing or reclamation of an underground mine.

1.3.2 Solution Mining

"The proposed action consists of the construction and operation of a borate production mine and process plant with the capability of producing 90,000 tons per year of borate product. The proposed facility would employ in-situ mining technology to mine an ore body containing colemanite, a boron-bearing, hydrous oxide ($Ca_2B_6O_{11} \bullet 5H_2O$) mineral. The recovery of boron from the colemanite mineral would be accomplished by injecting a weak acid solution (no more than five percent hydrochloric acid, sulfuric acid, or a mixture of both in a water solution) into the ore body. The acid would react with the alkaline nature of the ore body to recover a mixture of borate product and calcium chloride, which would be dissolved in solution as products of the chemical reaction. This solution would be withdrawn from the well and pumped to the process plant where borate crystals would be precipitated. The remaining formation would be a porous matrix of clays and insoluble minerals. The void space that would result from the leaching process would constitute less than 12 percent of the formation, and the void space would ultimately contain water, therefore subsidence is not expected to occur."

2. MINE WASTE

2.1 PROCESS

Solution mining by the patented cyclic process of regeneration of hydrochloric acid from calcium chloride does not create waste products. Only borate product and chemically inert gypsum, which will be sold to cement manufacturers, soil conditioning producers, or wall board manufacturers are produced from the pregnant well solution.

2.2 IN-PROCESS SOLUTION

The pregnant liquor contains a solution of borate product, sodium and calcium chloride, and a residual amount of hydrochloric acid. At the plant, it will be processed in fiberglass process equipment using construction materials that are compatible with the chemical constituents of the solutions.

2.3 GYPSUM

"Gypsum, a co-product of the borate mining operation, would be pumped in the form of a slurry from the process plant to the center of the gypsum deposition area. The water in which the gypsum will be pumped will be adjusted to a neutral pH. Neutralized water will percolate slowly out of the mounded deposit of gypsum and flow, via natural drainage patterns, to a low spot at the southern edge of the holding area. Water from the holding area will be collected and returned to the plant by a pump and pipeline system for reuse." This ponded area will be relatively small as water will be continually returned to the plant and minimal water loss is expected, primarily through evaporation and evapotranspiration. "The minerals and salts in the water will be removed as product during the boron extraction; therefore, the quality of the water used in the slurry is expected to be high. Gypsum, a calcium sulfate compound, is virtually insoluble in water (L. Ordway, 1992) and a quantitative analysis of the leachate solution completed by West Coast Analytical Services (WCAS) found no metals approaching legal Resource Conservation and Recovery Act (RCRA) limits. Results of chemical analysis of gypsum produced during pilot mining for CAM metals in TCLP leachate and total metals indicated that the gypsum produced as a byproduct of the borate mining operation constitutes a non-hazardous product."

"In the gypsum deposition area, gypsum would be impounded prior to being sold; i.e., to the local cement industry or the soil conditioning industry. Negotiations with interested purchasers are in progress." Marketing offers have been received (see Appendix D). "The gypsum deposition area would be approximately 16 acres in size and would consist of one dam, constructed of in-place materials. The height of the dam would be no greater than 50 feet. Plastic liners would be placed on the side of the dam that would be in contact with the gypsum slurry, and the dam would be constructed in accordance with California Division of Dam Safety requirements. No liner would be placed on the bottom of the deposition area.. The Lahontan Regional Water Quality Control Board (RWQCB) has been requested by FCMC to grant a waiver for waste discharge requirements for the gypsum deposition area because the gypsum to be stored in the area is considered a saleable product rather than a waste."

"The gypsum slurry would be delivered via an above-ground pipeline (up to six inches in diameter) leading to the area from the process plant. Over time, the gypsum would settle, and water would be removed from the top of the pond and returned to the process plant via an above-ground water return pipeline. This pipeline would be four inches in diameter and approximately one-half mile long."

2.4 OTHER WASTES

"Wastes generated by the operation of the process plant would include domestic garbage and used engine oil, grease, and solvents. Domestic garbage would be collected in a three to five-yard dumpster on site and removed off-site by a contractor as needed to the Barstow landfill. Oil (including that from the cogeneration facility), grease, and solvents would be removed from the project site to an approved recycling depot and hazardous waste facility. No hazardous wastes are generated by the process operation other than waste oil resulting from changing lubricating oil from the cogeneration unit. This waste oil would be hauled by a licensed recycler for recycle."

TABLE 2-1
ANTICIPATED PROJECT WASTE TYPES (Dames & Moore, 1993)

Waste Type	**Source Material**	**Disposal Procedure**
Domestic waste foods	Paper, plastic, glass,	San Bernardino County Landfill
Industrial (non-hazardous)	Concrete, plastic/ fiberglass pipe	San Bernardino County Landfill
Industrial (hazardous)	Spent oil	Licensed recycler

3. ORE PROCESSING METHOD

3.1 INTRODUCTION

The area of disturbance (i.e., the project site) resulting from the mining operation would consist of approximately 342.5 acres. The acreage of the project site is presented in Table 3-1.

TABLE 3-1
Acres Disturbed and Right-of-Way Information for the Project Site (Dames & Moore, 1993)

Facility	Acres Disturbed	Length of ROW (in feet)[1]	Width of ROW (in feet)	Acres of ROW
Well Field	273	N.A.	N.A.	N.A.
Process Plant	10	N.A.	N.A.	N.A.
Gypsum Deposition Area	16	N.A.	N.A.	N.A.
Electrical Transmission Line	0 [2]	7,280	25	4.1
Water Pipeline	19.2	41,860	20	19.2
Railroad Spur	7.6 [3]	12,740	100	29.2
Natural Gas Pipeline	0 [4]	10,560	25	5.9
Access Roads: #1	13.4 [5]	7,280	125	20.9
#2	2.1 [6]	N.A.	N.A.	N.A.
#3	1.2	N.A.	N.A.	N.A.
TOTAL ACRES DISTURBED:	342.5		TOTAL ROW ACRES:	79.3

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[1] Several of the facilities would not require rights-of-way, either because they would be placed on private land or because they are not the type of facility to which rights-of-way apply. These are designated by "N.A.," (not applicable), in the table above.

[2] The right-of-way for the electrical transmission line would occur within the right-of-way for the access road, therefore, no additional land disturbance would result.

[3] Only 25 feet of the 100 foot wide railroad right-of-way would be disturbed, hence, the disparity between the total right-of-way acreage versus the total disturbed acreage.

[4] The right-of-way for the natural gas pipeline would occur within the right-of-way for the access road, therefore, no additional land disturbance would result.

[5] Only 100 feet of the 125 foot right-of-way for Access Road #1 would be disturbed, hence, the disparity between the total right-of-way acreage versus the total disturbed acreage.

[6] Access roads #2 and #3 would occur on private land, therefore rights-of-way would not be required.

3.2 WELL FIELD FACILITIES

"The well field area would disturb approximately 273 acres and would ultimately be comprised of up to approximately 200 wells." The well field configuration is depicted in Figure 3-1. "Each well would be capable of operation in both the injection and recovery modes. Over time, as ore reserves are exhausted in specific localities, new wells would be drilled to replace those which are depleted."

"Materials used for well casings would consist of 4.5- to 6-inch diameter fiberglass and/or plastic pipe installed to the top of the ore body at the average depth of approximately 1400 feet. The casing would be held in place by forcing cement down its center and up through the space between it and the drill hole bore. In the basalt area, if needed, wells would have a surface conductor of 10-inch tubing to maintain drilling mud circulation through the lava. Wells would be installed to conform with the regulations of San Bernardino County."

"After the cement has set, the well would be completed by drilling out any remaining cement in the casing and drilling through to the bottom of the ore. Underreaming to enlarge the well bore surface area may be employed to facilitate extraction. Each well would be equipped with a flow meter."

"The well field would be operated in a “push and pull” mode, whereby the injection solution would first be injected into the well and then allowed to remain in the formation for a period of four to 12 hours to facilitate its reaction with the ore body. The pH of a sample of solution withdrawn from the well would be tested, and if it is found to be low (i.e., the solution is still acidic), the injection solution would be left in the well for a longer period of time. Once the chemical reaction is thought to have reached equilibrium, the boron-rich solution would be recovered by use of submersible pumps and pumped to the processing plant. With this mode of operation, approximately one third of the wells would be in the injection mode, one third in the reaction mode, and the remaining third in the recovery mode."

"The well field would be equipped with above-ground plastic trunk lines and a series of lateral collector lines to deliver injection solution and return recovery solution."

"Roads would be constructed in the well field to facilitate access and periodic maintenance procedures. In areas overlain with basalt, roads would be constructed by placing fill dirt from excavation of the gypsum deposition area over the lava to allow access for the drilling rigs and service equipment."

3.3 PROCESS PLANT FACILITIES

"The process plant facilities would consist of: (1) a solvent extraction facility, (2) a purification/crystallization facility, (3) a product loading and shipping facility, (4) acid regeneration and injection facility, (5) cogeneration facility, (6) ancillary services, and (7) process and storage tanks." The individual processing steps are detailed in Figure 3-2.

"One building would be constructed on the project site. This building, the process plant, would contain the process facilities, staff offices, cogeneration facility, a maintenance shop, and a product loading and shipping facility. The process plant is anticipated to be an enclosed building no longer than 600 feet long by 400 feet wide, with portions of the building being 75 feet high. The southwest end of the building would have a 140-foot extension, which would hold the acid regeneration and injection facility. The northeast end would have a 200-foot concrete pad extension, which would hold the initial crystal recovery system and the solvent extraction facility."

3.4 SOLVENT EXTRACTION FACILITY

"The solvent extraction unit would consist of up to six solvent extraction loading and six solvent extraction stripping cells. The loading and stripping cells would be identical and would consist of rectangular tanks approximately 15 feet wide by about 120 feet long, with a depth of about five feet. Each cell would be equipped with an electrical agitator. Auxiliary equipment would consist of carbon columns, pumps, surge tankage and necessary connecting piping. This equipment would be located on a cement pad extension northeast of the process building."

"The carbon in the carbon columns would require regeneration periodically. This would take place on site using elevated thermal regeneration. The organic solvent expelled from the carbon would be condensed and reused in the process. Some of the carbon would be degenerated to dust, but this dust would ultimately be burned, and the fumes routed to the cogeneration boiler system, as explained in the APCD Permit To Construct application. The well field recovery solution would be continuously recycled through the loading cells, in which the borate product would be extracted and then sent through the stripping cells. The stripped borate product solution would then be routed to the purification/crystallization facility."

3.5 PURIFICATION/CRYSTALLIZATION FACILITY

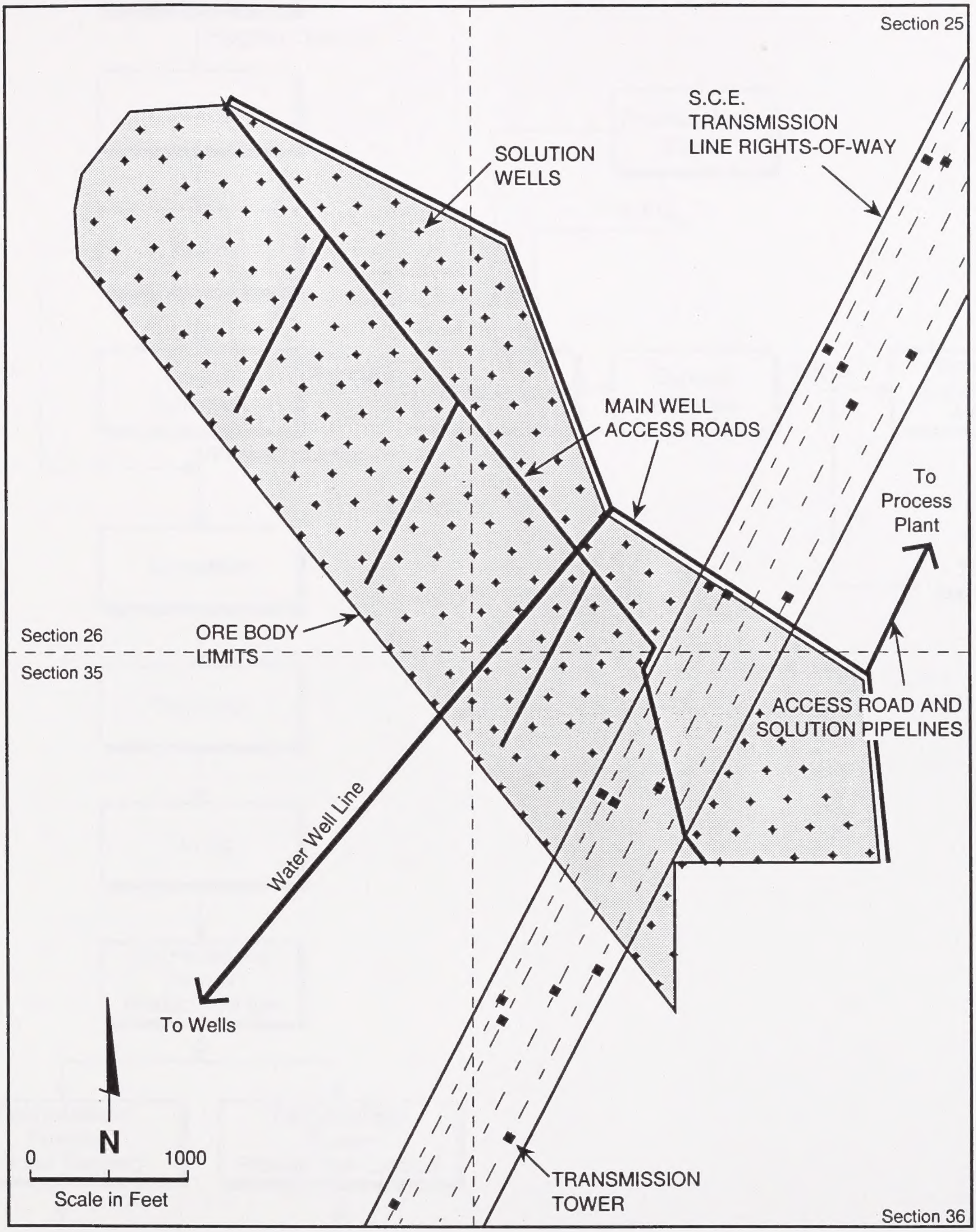
"In the purification/crystallization facility, impurities would be removed from the borate product solution and returned to the well and borate crystals would be formed. This facility would be comprised of dissolving tanks, polishing filters, activated carbon loading columns, and crystallization units. Once the purified borate crystals are formed, they would be routed to the product loading and shipping facility."

3.6 PRODUCT LOADING AND SHIPPING FACILITY

"The product loading and shipping facility would be located primarily inside the process plant and would consist of screening units to sort the product by size, dust collection equipment, up to eight storage bins, product bagging units, and bulk railroad and truck loading systems."

3.7 ACID REGENERATION AND INJECTION FACILITIES

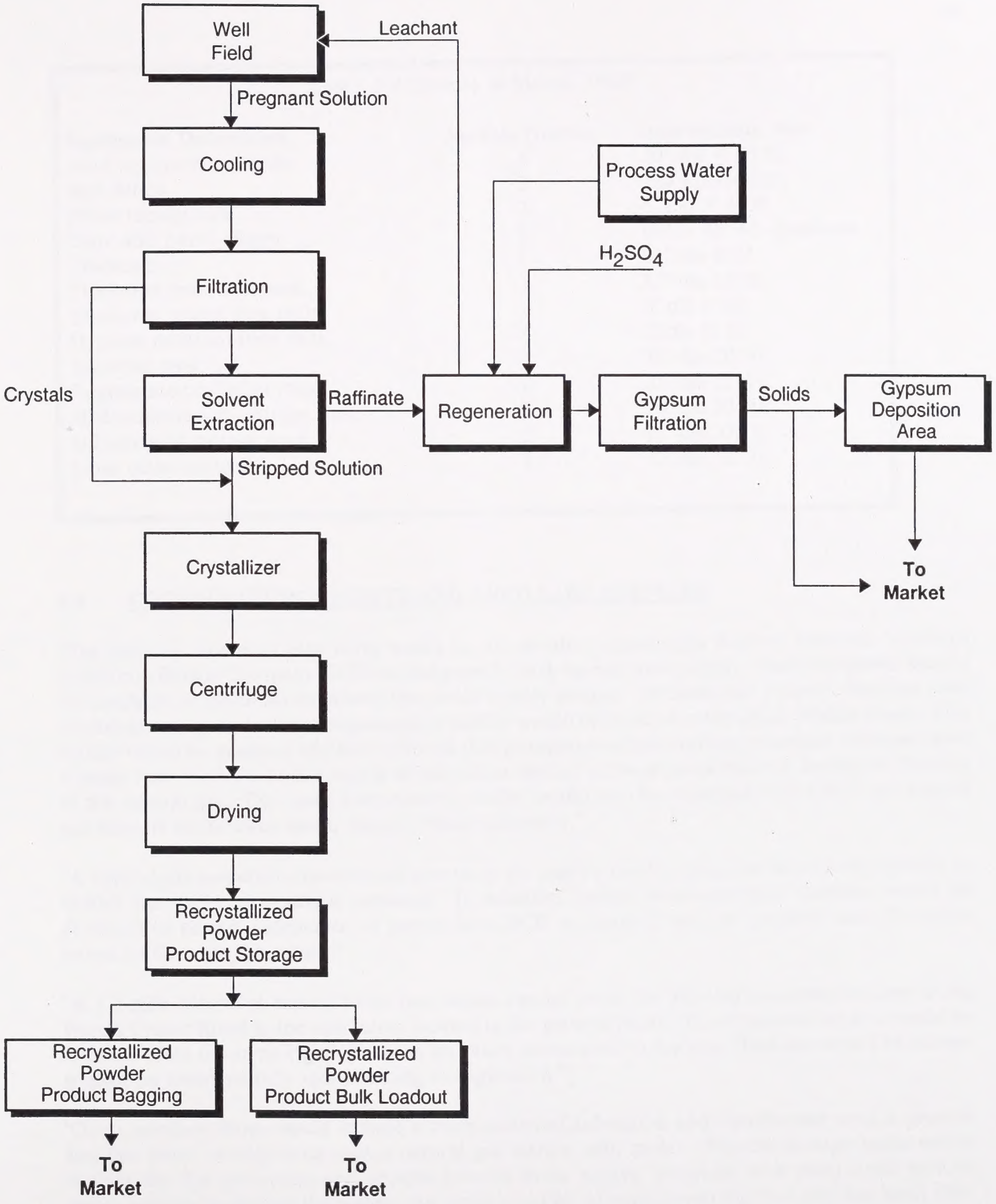
"The extension at the southwest end of the process building would contain the acid regeneration and well field injection equipment, including mix tanks, pH control equipment, acid surge tanks, acid pumps, filters, slurry advance pumps, gypsum thickener, and injection pumps." Dimensions and numbers of equipment to be used are detailed in Table 3-2.



REFERENCE: Administrative Draft Environmental Impact Statement / Environmental Impact Report
Fort Cady Minerals Corporation
Solution Mining Project
Prepared by Dames & Moore, March 1993

WELL FIELD CONFIGURATION
Fort Cady Mining and Land Reclamation Plan
Fort Cady Minerals Corporation
MARCH 1993

FIGURE 3-1



REFERENCE: Administrative Draft Environmental Impact
Statement / Environmental Impact Report
Fort Cady Minerals Corporation
Solution Mining Project
Prepared by Dames & Moore, March 1993

OVERALL PROCESS FLOW DIAGRAM

Fort Cady Mining and Land Reclamation Plan
Fort Cady Minerals Corporation
MARCH 1993

FIGURE 3-2

TABLE 3-2 (Dames & Moore, 1993)

Equipment Description	Approx. Number	Approximate Size
Acid regeneration tanks	5	10' dia × 10 H
Belt filters	2	120 square feet
Filter repulp tank	2	6' dia × 6' H
Plate and frame filters	2	48" × 48" 45 chambers
Thickener	1	35' dia 6' H
Thickener over flow tank	1	12' dia 12' H
Thickener under flow tank	1	6' dia 6' H
Gypsum neutralization tank	2	6' dia 6' H
Injection tank	4	29' dia 20' H
Regenerated solution tank	1	22' dia 22' H
Hydrochloric acid storage tank	2	16' dia 33' H
Sulfuric acid storage tank	2	16' dia 33' H
Lime make up tank	1	12' dia 12' H

3.8 COGENERATION FACILITY AND ANCILLARY SERVICES

"The primary source of electricity would be an on-site cogeneration facility; however, Southern California Edison Company (SCE) would provide back-up electrical supply. Electrical power should be available at all times to power the water supply pumps. Because the process requires both electrical energy and heat, a cogeneration facility would be located in the main process plant. This facility would be made up of a four-kilowatt (kW) natural gas-fired turbine generator equipped with a waste heat recovery boiler, which would utilize the hot exhaust gases created during the burning of the natural gas. The waste heat recovery boiler would also be equipped with additional natural gas burners to increase steam capacity when necessary."

"A natural gas-powered conventional generator set may be used in conjunction with the turbine to absorb the shifts in electrical demand. In addition, utility interconnection facilities would be provided to permit acceptance of power from SCE as needed, and the possible sale of surplus power to the utility in return."

"A 1.3-mile electrical transmission line would extend from the existing transmission line along Pisgah Crater Road to the substation located at the process plant. This transmission line would be located within the same right-of-way as the main access road to the site. This line would be above-ground on standard pole anti-perching configuration."

"Other ancillary items would include a main electrical substation and transformer area, a process and fire water storage area, and a natural gas station with meter. Process storage tanks would contain the fire protection and general process water supply, complete with pumps and various piping systems to deliver the water. An application for electric power right-of-way has been filed with the BLM in August of 1992."

"Since process water is unsuitable for drinking purposes, up to approximately 150 gallons per day of bottled drinking water would be imported. Alternately, potable water may be purified from process water using purification procedures. Sanitary sewage from the offices and process plant washroom areas, approximately 50 gallons per person per day, would be directed to a septic tank and tile bed system. The septic tank and tile bed system would be located adjacent to the northwest corner of the process building and would be approximately 100 feet × 200 feet in size."

3.9 PROCESS AND STORAGE TANKS

"A process water surge tank would contain non-potable water for use at the process plant. This tank would be 40 feet high and 40 feet in diameter and would be equipped with two centrifugal pumps."

"The majority of the process tanks (e.g., the solvent extraction loading cells, dissolving tanks, etc.) would be located at the process plant. Areas containing tanks would be located at both ends of the process plant on cement pads enclosed by cement berms. These bermed areas would be designed to contain process spill or storm water falling within the bermed area. Each bermed area would contain a below-grade sump equipped with a high-capacity pump and pipe manifold system capable of delivering the collected fluid to the desired location."

"Storage tanks would be located near the process plant in non-permeable, berm-enclosed containment areas. These areas would be capable of holding 1.5 times the volume of the largest tank enclosed within them."

3.10 RAILROAD SPUR, NATURAL GAS PIPELINE, AND ACCESS ROADS

"The railroad spur is estimated to be approximately 2.4 miles long and would extend from the process plant to the Atchison Topeka and Santa Fe (AT&SF) Railroad line to the northeast of the project site."

"The natural gas pipeline would be approximately two miles in length. The pipeline would be constructed between the process plant and the existing Pacific Gas and Electric Company (PG&E) main line. The tie-in would occur at the underpass of Pisgah Crater Road and I-40. The four-inch pipeline would be buried approximately 42 inches underground. It would parallel Pisgah Crater Road on the west side and follow the FCMC access road to the project site."

"Access to the site would be from Interstate-40 to the Hector Interchange, east on National Trails Highway, south on Pisgah Crater Road (a paved road), and west on a FCMC access road. Three access roads would be constructed for the proposed action. Roads would be constructed of native material (i.e., not paved). The first would be approximately 1.4 miles long and 30 feet wide and would extend from Pisgah Crater Road to the process plant. Overhead transmission lines, a buried natural gas pipeline, and a railroad line would be constructed within the same right-of-way as the access road."

"The second access road would be approximately one-half mile long and 20 feet wide and would extend from the process plant to the well field. Overhead transmission lines would also extend along this right-of-way. The pipelines for the injection of a weak acid and recovery of the boron-rich solution would also extend along this right-of-way. These above-ground pipelines would be constructed of plastic and/or fiberglass. Various temporary roads within the well field would be constructed in order to provide access for well, pipeline, and transmission line maintenance."

"The third access road would extend from the process plant to the gypsum deposition area. This road would also be approximately one-half mile long and 20 feet wide. A plastic and/or fiberglass slurry delivery pipe, a plastic water return pipe, and a transmission line would extend along the same right-of-way. Applications for Federal Land Policy and Management Act Title V rights-of-way have been filed for the railroad spur and access roads, and for the natural gas pipeline in May 1991."

4. WATER DATA

4.1 WATER SUPPLY

"Approximately 150,000 gallons per day (or 0.46 acre feet per day, for a total of approximately 161 acre feet per year) of process water would be required for the proposed action in order to wash the gypsum produced, and for use in cooling, fire protection, and various sanitary uses." The process water will be pumped from wells west of the Pisgah Fault. The chemical analysis of water from well MM-1, located just west of the Pisgah Fault is shown in Table 4-1.

"The above-ground main water delivery line would have a diameter of three inches, and the above-ground delivery lines from the individual water wells to this main delivery line would be three inches or less in diameter, depending upon the yield of the individual wells. The distance from the farthest well to the process plant would be approximately eight miles. An application for the Federal Land Policy and Management Act Title V right-of-way for the water pipeline was filed with the BLM on July 9, 1990."

"The water well locations and transmission pipeline routes have been located on mill site claims HMS 1 through 128 and 130 through 474. These claims were filed with the BLM on September 18, 1989, and have been assigned California Mining Claim serial numbers 229645 through 230117."

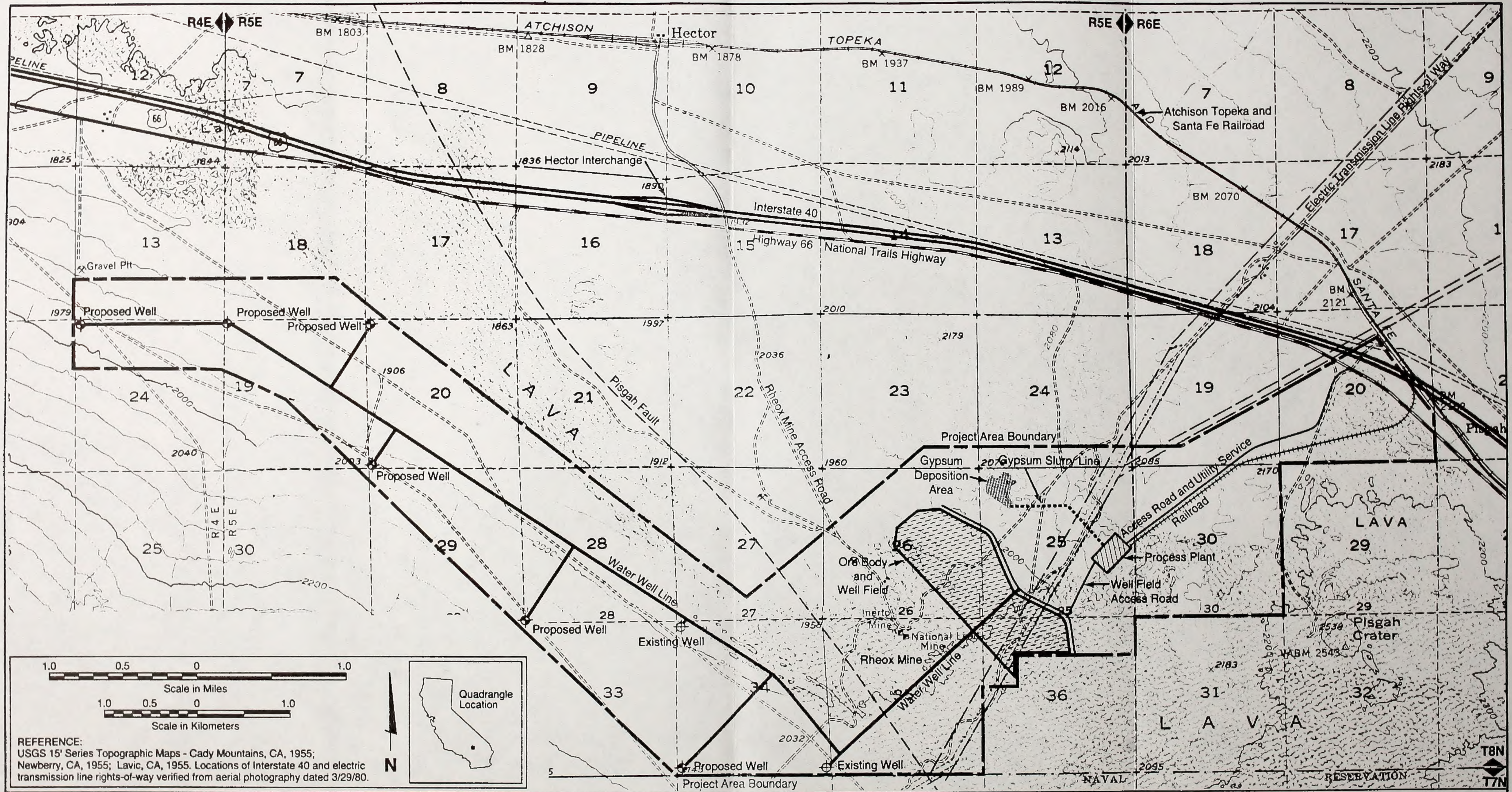
	TABLE 4-1 PROCESS WATER ANALYSIS (Dames & Moore, 1993)				
Well No.	**Process Water MM-1 (West of Pisgah Fault)**				
Date	**2/8/82**	**2/8/82**	**2/9/82**	**2/9/82**	**4/2/91**
SILICA OXIDE, mg/l	-	-	-	-	-
SILICON, mg/l	-	-	-	-	-
SILVER, mg/l	-	ND	-	-	-
SODIUM, mg/l	445	375	503	500	450
SODIUM (WET), mg/l	-	-	-	-	-
STRONTIUM, mg/l	-	0.03	-	-	-
SULFATE, mg/l	1,060	900	1,200	1,180	830
SULFATE (WET), mg/l	-	-	-	-	-
TIN, mg/l	-	-	-	-	-

	TABLE 4-1 PROCESS WATER ANALYSIS (Dames & Moore, 1993)				
Well No.	**Process Water MM-1 (West of Pisgah Fault)**				
ZINC, mg/l	-	0.03	-	-	-
TOTAL ALKALINITY, mg/l	-	95	-	-	-
HARDNESS, mg/l	300	320	325	310	-
CARBON DIOXIDE, mg/l	3.5	-	4.4	3.5	-
CHLORIDE, mg/l	61	60	61	59	65
CHLORIDE (WET), mg/l	-	-	-	-	-
CHROMIUM, mg/l	-	0.01	-	-	-
COPPER, mg/l	-	0.01	-	-	-
FLUORIDE, mg/l	-	1	-	-	-
IRON, mg/l	0.15	0.1	0.23	0.25	ND
LEAD, mg/l	-	0.02	-	-	-
LITHIUM, mg/l	-	-	-	-	-
MAGNESIUM, mg/l	14	12	17	14	-
MAGNESIUM (WET), mg/l	-	-	-	-	-
MANGANESE, mg/l	-	0.01	-	-	-
MERCURY, mg/l	-	ND	-	-	-
NICKEL, mg/l	-	-	-	-	-
NITRATE, mg/l	12	32	15	15	-
PHOSPHATE, mg/l	-	-	-	-	-
POTASSIUM, mg/l	-	10	-	-	5.6
SELENIUM, mg/l	-	ND	-	-	-
TEMPERATURE, ^{oC}	-	-	28	28	-
pH, units	7.52	7.3	7.6	7.6	8.5
TDS, mg/l	1,860	1,640	1,974	1,944	1,440
CONDUCTIVITY, mmhos/cm	2,800	2,180	2,800	2,800	2,030
ALUMINUM, mg/l	-	-	-	-	-
ARSENIC, mg/l	-	0.03	-	-	-

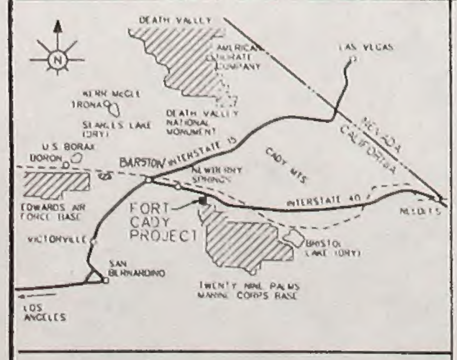
	TABLE 4-1 PROCESS WATER ANALYSIS (Dames & Moore, 1993)				
Well No.	**Process Water MM-1 (West of Pisgah Fault)**				
BARIUM, mg/l	1	ND	1	1	-
BICARBONATE, mg/l	115	116	122	122	-
CARBONATE, mg/l	-	-	-	-	-
BORON, mg/l	5	6	5	5	11.03
BORATE (B_2O_3), mg/l	-	-	-	-	-
BORATE (HBO_3) (WET), mg/l	-	-	-	-	-
CADMIUM, mg/l	-	ND	-	-	-
CALCIUM, mg/l	98	108	104	102	49
CALCIUM (WET), mg/l	-	-	-	-	-

5. EROSION AND SEDIMENTATION CONTROL

Wind and water erosion and sedimentation will be controlled by several methods. Reclamation will emphasize grading practices that enhance the natural reestablishment of native vegetation. The disturbed areas of the site will be graded to eliminate rills and gullies. These areas will be regraded and imprinted to create non-uniform, rough surfaces in order to decrease wind velocities, increase seed and fines deposition and improve moisture collection. Materials (vegetative debris and rocks) that remain from the initial grading of project-related linear features, the gypsum deposition area, and the process plant will be redistributed in a non-uniform manner designed to decrease wind and water erosion and create habitat conductive to plant reestablishment. Snow fencing may also be used to create wind breaks. Seeding of native perennial species will also enhance site recovery and reduce erosion potential. Additional measures, such as the incorporation of growth enhancers or the installation of erosion control fabrics, may be required to control erosion.



REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.



LOCATION MAP
N.T.S.

MINING PLOT PLAN

PRODUCTS:
BORATE PRODUCT
GYPSUM

MINE OPERATOR:
FORT CADY MINERALS CORPERATION
P.O. BOX 100
NEWBERRY SPRINGS, CALIFORNIA
92365
GEORGE HARTMAN, GENERAL MANAGER
TEL (619) 257-4079

LEASED LAND OWNER:
RHEOX INC. (FORMERLY NL INDUSTRIES INC.)
WYCOFF MILLS ROAD
P.O. BOX 700
HIGHTSTOWN, NEW JERSEY 08520
W.R. BRONNER, VICE PRESIDENT/GENERAL COUNCIL
TEL. (609) 443-2323

APPLICANT/LEASEE REPRESENTATIVE:
FORT CADY MINERALS CORPORATION
P.O. BOX 100
NEWBERRY SPRINGS, CALIFORNIA
92365
TEL. (619) 257-4079

MINERAL RIGHTS:
1. RHEOX INC.
2. SOUTHERN CALIFORNIA EDISON CO.
3. SOUTHERN PACIFIC LAND COMANY
4. FORT CADY (CALIFORNIA) CORPORATION

CIVIL ENGINEER:
KILBORN INTERNATIONAL LTD
1600 NEW YORK STREET
SUITE 201
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UTILITY PURVEYORS:
ELECTRICITY, SOUTHERN CALIFORNIA EDISON
NATURAL GAS, PACIFIC GAS & ELECTRIC CO.
TELEPHONE, CONTEL
WATER, PRIVATE WELLS
SEWER, PRIVATE SEPTIC SYSTEM

ASSESSORS PARCEL NUMBERS-LEGAL DESCRIPTION:
529-251-01, SANTA FE PACIFIC LAND CO.
529-251-02 & 08, SOUTHERN CALIFORNIA EDISON CO.
529-251-03 TO 05, FORT CADY (CALIFORNIA) CORPORATION
529-011-01, FORT CADY (CALIFORNIA) CORPORATION
529-641-09, NL CHEMICALS
529-221-02, NL CHEMICALS

FACILITY	TOTAL ACRES DISTURBED
WELL FIELD	273
PROCESS PLANT	10
GYPSUM DEPOSITIONAL AREA	16
ELECTRICAL TRANSMISSION LINE	0
WATER PIPELINE	19.2
RAILROAD SPUR	7.6
NATURAL GAS PIPELINE	0
MAIN ACCESS ROAD	13.4
GYPSUM DEPOSITIONAL SERVICE ROAD	2.1
WELL FIELD SERVICE ROAD	1.2
TOTAL	342.5

NOTE:
PROMINENT SPECIES ARE TYPICAL OF MOJAVE CREOSOTE SCRUB AND DESERT SALTBRUSH SCRUB. NO YUCCAS, JOSHUAS OR RARE OR ENDANGERED PLANT SPECIES EXIST ON THE SITE. REFER TO RECLAMATION PLAN TEXT FOR DETAIL.

PREPARED:
NOVEMBER 27,1989

REVISED:
APRIL 7, 1993

LAND RECLAMATION PLAN

LAND RECLAMATION PLAN

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LAND RECLAMATION PLAN

1. INTRODUCTION

In-situ solution mining provides many environmental and subsequent reclamation advantages compared to conventional open pit or underground mining operations. The proposed solution mine operation will not produce open pits, overburden dumps, mill tailings, or process wastes.

The proposed project will result in 342.5 acres of disturbance, including a 273-acre orebody well field with 200 wells located on the ore body, a 10-acre plant site, a 16-acre gypsum deposition area, and 43.5 acres of ancillary services, including a process water supply well network, a railway spur, a natural gas pipeline, access roads, and electric lines and facilities.

1.1 LAND USE

The project is located approximately 17 miles east of Newberry Springs and two and one-half miles south of Interstate 40 (I-40). Land uses adjacent to the site include the following:

North: Open space, I-40 two and one-half miles north, and A.T. & S.F. railroad line four miles north.

East: Open space, SCE high-voltage transmission lines and corridors, Pisgah Crater two miles east, and 29 Palms Marine Corps Base one mile southeast.

South: Rheox Inc.'s open pit hectorite mine adjacent to the site and Rodman and Lava Mountains four miles south.

West: Rheox Inc. Hector Mine access road and open space.

"Although no established recreation areas or facilities are located on or near the project site, dispersed off-road recreation does occur where access is obtainable from the National Trails Highway or other local area roads. The Pisgah Crater lava flow, which covers portions of the project area, has historically been used for scientific research. The lava flow has been designated as a Research Natural Area in the California Desert Conservation Area (CDCA) Plan, but no specific recreation or land use management policies presently exist for this designation." The area is located in a proposed Area of Critical Environmental Concern (ACEC). Wilderness study areas (WSAs) associated with Congressional legislation do not occur in close proximity to the site. The nearest WSAs are approximately 20 miles to the west and southwest of the project area. At this time, the remainder of the area is designated as desert open space (see Section 3.6 of the FCMC Solution Mining Project Draft EIS/EIR for more information) (Dames & Moore, 1993).

The project site has been the center for exploration, pilot scale solution mining, and pilot plant testing for the recovery of borates since 1964. A brief history of these activities is discussed in Section 1.1.2 of the Mining Plan. The locality is isolated with no nearby permanent residential or commercial development. Recreation in the area is limited due to inaccessibility and existing mining operations.

1.2 VISIBILITY

I-40 is located two and one-half miles to the north, but, with the exception of the Process Plant building, much of the site is visually blocked by a low ridge. The Process Plant building has a height of 50 feet, with associated storage silos up to 75 feet. Other facilities have a lower profile resulting in minimum visual impact from other vantage points (see Section 3.7 of the FCMC Solution Mining Project Draft EIS/EIR for more information) (Dames & Moore, 1993).

1.3 VEGETATION

Creosote bush shrub is the primary vegetative type in the project area. Two major community types, white bursage (Ambrosia dumosa) and creosote bush (Larrea tridentata) occur on the proposed project site. Other plants include bladder sage (Salazaria mexicana), cheesebush (Hymenoclea salsola), beavertail cactus (Opuntia basilaris), Anderson thornbush (Lycium andersonii), and Mohave yucca (Yucca schidigera). Appendix F contains a complete list of plant species observed during field surveys conducted in 1989 and 1990 (Dames & Moore, 1993). No Federal or State listed species are known or expected to occur in the project area, and there are no trees in the area (see Section 3.5 of the FCMC Solution Mining Project Draft EIS/EIR for more information) (Dames & Moore, 1993).

1.4 WILDLIFE

"The fauna associated with creosote bush scrub are adapted to desert scrub habitat with little cover and xeric conditions. Fish and amphibians are rare due to the scarce nature of surface water. Reptilian fauna, in contrast, are much more common and diverse. Special species of snakes occur in the project area, which are significant predators of the small mammals found in the area. Lizards are also expected on or near the project area. The desert tortoise (Xerobates [formerly Gopherus] agassezii), is also a year-round resident of the area."

"A wide variety of avian species may be found on or near the project area. Many breed in the area and are year-round residents, while others are seasonally abundant." Appendix F contains a complete list of wildlife species observed during field surveys conducted in 1989, 1990, and 1991 (see Section 3.5 of the FCMC Solution Mining Project Draft EIS/EIR for more information) (Dames & Moore, 1993).

"Based on literature review and reconnaissance field surveys, nine sensitive wildlife species are known or have the potential to occur in the project area. Of those, two are Federally-listed species (the desert tortoise and peregrine falcon). The desert tortoise is also State-listed as threatened, and the peregrine falcon is State-listed as endangered. A separate Biological Assessment for the desert tortoise was submitted to USFWS as part of the Section 7 consultation required by the Endangered Species Act, as amended" (see USFWS Biological Opinion, Appendix F).

"Seven additional sensitive species are known, or have the potential, to occur in the project area. One lizard, two birds, and four mammals are Federal candidates and/or state-protected species, including the prairie falcon, LeConte's thrasher, the desert kit fox, Nelson's bighorn sheep, the California leaf-nosed bat, the spotted bat, and the common chuckwalla."

2. RECLAMATION

2.1 PRE-CONSTRUCTION SURVEYS

A pre-construction baseline vegetation survey will be conducted within the disturbed area prior to construction to evaluate community characteristics and structure. The survey will be conducted during peak flowering and fruiting periods to ensure correct species identification. This information will be essential to refinement of proposed revegetation prescriptions and to set realistic performance standards.

Diversity (species richness) and density of perennial vegetation for each community type proposed for disturbance are the currently accepted measurements of vegetative structure in the Mojave Desert. Cover is not considered to be an accurate measure of revegetation success. For many desert perennials, years may be required for above-ground biomass (canopy cover) to equal and exceed below-ground biomass.

It appears that two major community types, white bursage (Ambrosia dumosa) and creosote bush (Larrea tridentata) occur on the proposed project site. Two permanent "control" plots will be located, one in each community, outside proposed areas of disturbance. These plots will be representative of vegetation occurring in areas proposed for construction and constitute "control" plots, by which reclaimed areas can be compared. Prior to actual reclamation, the undisturbed "control" plots will be resurveyed to evaluate changes in vegetative composition that may have occurred since project inception.

The exact location of the "control" plots will be determined following construction staking. Plots will be 100 yards squared, with grids on 10-yard intervals. At each intersection, a circular plot, two yards squared, will be measured. Sample size will be sufficient to produce at least an 80 percent confidence interval, for each grid sampled.

2.2 CONSTRUCTION PHASE

The proposed solution mine operation will cause relatively little grading and associated soil disturbance. Open pits, overburden dumps, tailings and mine waste, all frequently associated with large mining operations, will not occur as part of this project.

Significant surface disturbance and earth moving will be restricted to the gypsum deposition area (16 acres) and the processing plant (10 acres). Removal of a limited amount of vegetation will be required within the well field (273 acres). Disturbance of vegetation is also anticipated as a result of construction of the railroad spur (7.6 acres), new roads (16.7 acres), and the waterline (19.2 acres).

2.3 OPERATIONS

The process plant, gypsum deposition area, railroad spurs and access roads will remain active for the duration of the mine operation (approximately 130 years). It is expected that a market for the waste gypsum will be developed and that gypsum will be continuously exported.

2.4 OREBODY WELL FIELD CLOSURE

As the mineral reserves become depleted, wells will be destroyed and reclaimed. This process includes backfilling the casing with sand or pea gravel below 20 feet; sealing with impervious material (i.e., concrete or cement grout) in the upper 20-feet of the well; and backfilling the shaft with native soils (see permit requirements for well destruction, County of San Bernardino, Department of Environmental Health Services, January, 1990). The remaining surface disturbance will be revegetated in accordance with other specifications developed for that plant community type.

2.5 FINAL RECLAMATION

Final reclamation will emphasize grading practices that enhance the natural reestablishment of native vegetation. Regrading will create non-uniform, rough surfaces to decrease wind velocities, increase seed and fines deposition, and improve moisture collection.

Following the removal of all structures and equipment from the site, all remaining active wells will be plugged, as described above. All areas that initially required excavation will be returned to their original grade and will conform with the surrounding topography.

The dam retaining the gypsum deposition area will be removed and the site returned to as close to original contour as possible, conforming with surrounding topography. Depending on the degree of soil contamination and influence on plant establishment, some soils in the deposition area may be cleansed or excavated and properly disposed.

All compacted soils will be ripped at a minimum depth of eight inches, in two perpendicular passes, on slopes less than 3:1. Ripping depth will be determined by evaluating the depth and quality of subsoil at the site. All areas to be revegetated will also be imprinted on slopes less than 3:1. Use of an imprinting device creates a rough soil surface that allows development of microsites conducive to seedling establishment.

Remaining materials (vegetative debris and rocks) resulting from initial grading shall be non-uniformly redistributed, perpendicular to the prevailing wind, where feasible, following final grading and imprinting. This material will serve to trap soil particles, wind-borne seed, and soil moisture. Snow fencing, or other suitable material, may also be used as a wind break and to direct wind-born deposition.

3. REVEGETATION

Revegetation objectives are to provide immediate and long-term site stability through the reestablishment of a self-perpetuating, native plant community that allows for natural plant succession. The use of soil amendments (including fertilizers), mulches or tackifiers, is not anticipated.

Following final grading and imprinting, disturbed areas will be seeded with an appropriate mix at a rate developed from data obtained from vegetation survey(s). It is expected that the mix(s) will include the co-dominant species of creosote and bursage. Both of these species produce seed that can be established by broadcast seeding. The mix will also be determined by the ability of species to become established from seed and to reduce visual contrasts with the surrounding landscape. If possible, seeds will be lightly covered with soil.

Given the anticipated life of the mining operation (approximately 130 years), the assumption can be made that desired species will be commercially available, and seeding specifications will be adjusted, if necessary, in accordance with the best available technology at the time of final reclamation.

4. CLEANUP

All structures, solution and process water wells, equipment, pipelines and tanks will be dismantled. Salvageable items will be offered for sale and removed from the site following termination of operations. All nonsalvageable material will be properly disposed at an approved landfill site. Cleanup will take place throughout the production phase and as facilities are closed.

5. POST-RECLAMATION AND FUTURE MINING

The reclaimed site will appear similar to preexisting conditions. Original contours will be reestablished where possible. Post-reclamation land use will not be in conflict with adjacent land uses. No future mining of colemanite is anticipated on the present site following mine closure.

6. SLOPES

The only major slope on the project site requiring reclamation consists of the earth dam constructed to detain gypsum. The dam will be reclaimed as described in the following section.

7. GYPSUM DEPOSITION AREA

The dam will be constructed from materials removed during excavation. If any gypsum remains in the deposition area, it will be covered with material from the dam. Dam liners will be removed and disposed of in accordance with established regulations. Regrading will proceed to complete dam removal, backfilling the excavated deposition area and returning it to a contour in conformation with surrounding topography. Soils will then be tested for nutrients, and if they are found to be deficient, fertilizer may be used in this area to enhance the reestablishment of vegetation. The revegetation will proceed as described above.

8. SOILS

The soil throughout the northern part of the project area of the Daggett-Tonopah-Bitterspring association, which range from gravelly, sandy loam to sand, are largely covered with desert pavement. Thick, medium-textured vesicular crusts and subsurface horizons with clay accumulations typically underlie the surface rock cover. In the alluvial areas Anthony-Cajon-Arizo association soils occur, typically ranging from sandy loam to gravelly sand.

9. DRAINAGE AND EROSION CONTROL

No significant changes in runoff patterns are anticipated. Wind and water erosion will be controlled through regrading, which will create non-uniform, rough surfaces to decrease wind velocities, increase seed and fines deposition, and improve moisture collection. In addition, erosion will be further controlled by imprinting and seeding disturbed areas.

In the event that any rill or gully erosion occurs, addition measures, such as the incorporation of growth enhancers or the installation of erosion control fabrics, or reseeding may be required to control erosion.

10. PUBLIC SAFETY

Since the proposed solution mine operation will not produce open pits, overburden dumps, mill tailings, nor process wastes and mine-related facilities will either be removed and disturbed land reclaimed and revegetated, no public hazards are anticipated. Therefore, posted warning signs will not be needed.

11. MONITORING AND MAINTENANCE

Baseline monitoring during project construction and implementation will include the following:

a. Hydrology of the formation containing the ore reserves.
b. Water quality of the formation water within the ore body.
c. Water quality and quantities of process ore body.
d. Quality and quantities of leachate, pregnant and process solutions.
e. Climatological data from nearby locations.

Evaluations will continue throughout the life of the mine to enhance the success of reclamation and revegetation activities. The mine will maintain contact with other similar mines, research facilities and government agencies to ensure awareness of state of the art techniques and methodologies. It will be the responsibility of the mine to stay current with and update these specifications as needed.

Once reclamation activities begin, periodic evaluations of reclamation success will be submitted to the lead agency. These reports will also include analysis of other appropriate documents from related projects. Since plant establishment in desert communities can be extremely slow, it is unrealistic to expect total reestablishment of vegetative diversity and density after 10 years. Based on previous research, the following performance goals will be achieved 10 years following closure: density of 21 percent of "control" (survey plots or adjacent undisturbed plant communities), and diversity of 15 percent of "control". The operator will also show that the vegetation has been self sustaining for two years.

Periodic maintenance, such as reseeding with selected species, regrading to eliminate rills or gullies, application or installation of soil stabilizers may be required to control erosion and achieve revegetation standards. No other maintenance of vegetation is anticipated.

12. RECLAMATION ASSURANCE

12.1 COST CALCULATIONS FOR OREBODY WELL FIELD CLOSURE

A total of 200 wells up to 1500 feet deep will be destroyed and reclaimed. Five cubic yards of material will be needed to fill each well. The well closure process includes backfilling the casing with sand or pea gravel below 20 feet; sealing with impervious material (i.e., concrete or cement grout) in the upper 20-feet of the well; and backfilling the shaft with native soils. The remaining surface disturbance will be revegetated in accordance with other specifications developed for that plant community type.

A. Equipment

Item	$ per hour (includes operator)	Hours per well	# Wells	Total Cost
Backhoe	50	.5	200	$5,000
10 yard End Dump	50	4	200	$40,000
Total Equipment Costs				**$45,000**

B. Labor

Item	$ per Hour	Hours per Well	# Wells	Total Cost
Laborer	15	4	200	**$12,000**

C. Materials

Item	Cubic Yards per Well	$ per Yard (delivered)	# Wells	Total Cost
Sand or pea gravel	5	2	200	$2,000
Cement	.1	100	200	$2,000
Total Material Costs				**$4,000**

TOTAL COST MATERIALS, EQUIPMENT AND LABOR **$61,000**

12.2 COST CALCULATIONS FOR REVEGETATION

Areas to be revegetated include all areas disturbed as a result of mining operations. These include the gypsum holding area, well field, plant, transmission line, all right of ways, railroad spur, access roads and water line. Final reclamation will emphasize grading practices that enhance the natural reestablishment of native vegetation. During final grading, compacted soils will be ripped and imprinted. Regrading will create non-uniform, rough surfaces to decrease wind velocities, increase seed and fines deposition, and improve moisture collection. Areas that initially required excavation will be returned to their original grade and will conform with the surrounding topography. All disturbed areas will be seeded with a native seed mix.

A. Equipment

Item	Quantity	$/Hour (includes operator)	Total Hours	Total Cost
Cat D8L w/rippers	2	70	100	7,000
Cat w/imprinter	2	70	100	7,000
Backhoe w/clamshell and thumb	1	50	35	1,750
Cat 631 Scraper	1	50	200	10,000
Cat 12G Grader	1	50	200	10,000
Water Truck	1	40	200	8,000
10 yd. end dump	1	50	35	1,750
Total Equipment Cost				**$45,500**

B. Labor

Item	Quantity	$/Hour	Total Hours	Total Cost
Laborer (seeding)	2	15	80	**1,200**

C. Materials

Item	$/Lb	lb/Acre	# Acres	Total Cost
Native Seed Mix	10	20	342.5	**$68,500**

TOTAL COST MATERIALS, EQUIPMENT AND LABOR	**$115,200**

12.3 COST CALCULATIONS FOR REGRADING GYPSUM POND

Regrading will include complete removal of the gypsum dam, backfilling the excavated deposition area, and returning the area to a contour in conformation with surrounding topography. Approximately 380,160 cubic yards of material will be regraded.

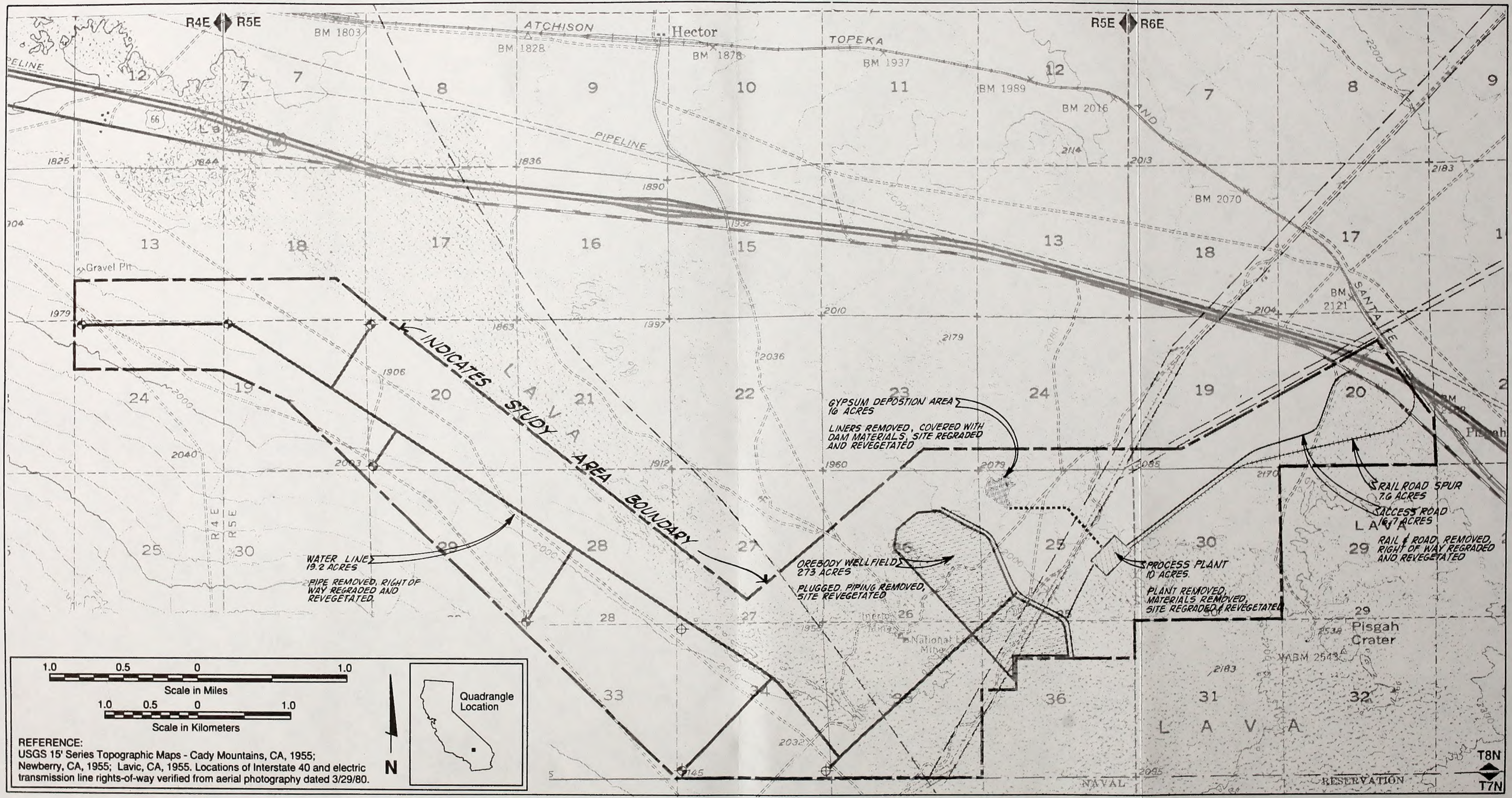
A. Equipment

Item	Quantity	$/Hour (includes operator)	Total Hours	Total Cost
Cat D9N Dozer	2	50	292	14,600
Cat 12G Grader	1	50	8	400

TOTAL COST EQUIPMENT	**$15,000**

12.4 TOTAL COST CALCULATIONS FOR RECLAMATION

12.1	OREBODY WELL FIELD CLOSURE	$61,000
12.2	REVEGETATION	$115,200
12.3	REGRADING GYPSUM POND	$15,000
	MISCELLANEOUS COSTS	$30,000
	SUBTOTAL	**$221,200**
	20% COUNTY OVERHEAD COSTS	$44,240
	ESTIMATED TOTAL FINANCIAL ASSURANCE	**$265,440**


R4E R5E
R5E R6E
ATCHISON
TOPEKA
AND
SANTA FE
Hector
PIPELINE
Gravel Pit
LAVA
L A V A
Pisgah
Pisgah Crater
National Mine
NAVAL
RESERVATION
T8N
T7N
INDICATES STUDY AREA BOUNDARY
GYPSUM DEPOSTION AREA 16 ACRES
LINERS REMOVED, COVERED WITH DAM MATERIALS, SITE REGRADED AND REVEGETATED
WATER LINE 19.2 ACRES
PIPE REMOVED, RIGHT OF WAY REGRADED AND REVEGETATED.
OREBODY WELLFIELD 273 ACRES
PLUGGED, PIPING REMOVED, SITE REVEGETATED
PROCESS PLANT 10 ACRES.
PLANT REMOVED, MATERIALS REMOVED, SITE REGRADED & REVEGETATED
RAIL ROAD SPUR 7.6 ACRES
ACCESS ROAD 16.7 ACRES
RAIL & ROAD REMOVED, RIGHT OF WAY REGRADED AND REVEGETATED
1.0 0.5 0 1.0
Scale in Miles
1.0 0.5 0 1.0
Scale in Kilometers
N
Quadrangle Location

REFERENCE:
USGS 15' Series Topographic Maps - Cady Mountains, CA, 1955; Newberry, CA, 1955; Lavic, CA, 1955. Locations of Interstate 40 and electric transmission line rights-of-way verified from aerial photography dated 3/29/80.

RECLAMATION PLOT PLAN

FORT CADY PROJECT
NEWBERRY SPRINGS, CALIFORNIA

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